DECEMBER, 1953

FLYING SAFETY

UNITED STATES AIR FORCE

Holiday Greetings

...th Flying Safety presents you with
a special all-jet issue.

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FLYING SAFETY

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There is no "Well Done" this month since no nominations were received in time due to the new selection procedures now in effect.

★ ★ ★

Are you sure of your ejection procedures? If not, see page 14.

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COVER: "Christmas At Home," by S/Sgt Nicholas Shekitka

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SUBSCRIPTIONS

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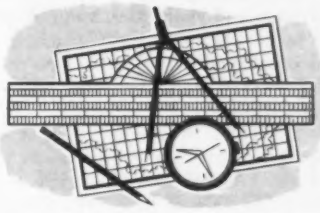
USAF PUBLICATION 62-1

Careful flight planning pays off in safety. Don't take unnecessary chances trying to save some time.



PLANNING YOUR FLIGHT

THE problems in jet flight planning are not entirely new. Most of them are the big brothers of the problems which arose in flying conventional aircraft. Endurance, range, weather; all the old problems are still here. With a jet, however, the newest wrinkle is the combination of short endurance and comparatively long range. This range, in turn, means a larger variety of weather on a single flight. In short, the jet lumps several old problems together and tosses them in your lap on every flight.

There's little that is drastically new in the solution of these problems. It's still called flight planning, only now it's done in greater detail.

There is one system, however, that pays off every time. It's been proven in flight to be basically sound, and, if used properly, guarantees no unscheduled hikes from the "boondocks" to destination.

It's a system that entails more work than the average pilot ordinarily devotes to the business of going from here to yonder. But out of the detailed planning on which the system is based have come Climb Compensation Charts and Flight Logs that actually simplify jet flight planning to the point where the time factor is no longer prohibitive.

Check The Weather

It all starts with a trip to the weather office. You're covering a lot of ground in a short time and you can expect fairly rapid changes in the weather through which you are travelling. If a check on the weather reveals that your flight can be conducted under visual flight rules, the problem is made easier. But where instrument flight conditions are forecast, detailed flight planning is a must for consistently successful jet flight.

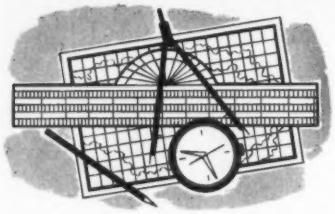
Let the forecaster know what you want. Tell him the type aircraft you are flying, altitudes you expect to fly, your ETE and any additional information which will assist him in visualizing your problem. Once you have given the forecaster this information, he is then equipped to brief you fully and accurately on the weather that will affect your individual flight. When getting your weather briefing, remember to get forecast as well as existing weather. When the forecaster has finished his briefing, you should have the following data:

Destination: Ceiling, visibility, freezing level, tops of clouds and precipitation.

En route: Ceilings, visibilities, cloud types at flight altitudes, tops of clouds, turbulence, temperatures aloft and winds at flight altitudes.

Takeoff Point: Ceiling, visibility, freezing level and temperatures and winds up to flight altitude.

Sounds involved, doesn't it? But it's only a matter of minutes to get



this information. Once you have it, you have all the weather information necessary to plan an instrument flight successfully, and, equally important, you have the answer to that big question, "Where's the best place to go?" if an inflight emergency occurs.

Knowledge of the ceiling, visibility and freezing level at your destination is imperative. It's also vitally important to know the type and intensity of precipitation which exists or is forecast at your destination. Poor cockpit visibility may turn an otherwise routine approach into a fast session of low level aerobatics with disastrous results.

Temperatures and winds up to flight altitudes must be known to compute accurately the distance to be covered during your climb and the fuel to be consumed.

With a complete picture of en route ceilings and visibilities, valuable time is saved when an aircraft malfunction or other emergency forces you to decide where you can land with the least difficulty.

The types of clouds at flight altitudes will give the pilot a good idea of the kind of low frequency radio reception he will have. The presence of turbulence in the ice crystal zone will virtually assure that corona static will be present. Frequently ice crystal clouds will cause corona static of such intensity that the low frequency radio will be useless and navigation must be dead reckoning.

Weather at takeoff point is an item often neglected in flight planning. Knowledge of this weather will be the deciding factor when a decision must be made either to return to destination or continue to an alternate in the event of an emergency soon after takeoff. A forecast on weather at takeoff point may bring out a future weather condition not apparent to the casual observer.

Alternates should be chosen approximately 200 miles apart, or if possible, within gliding distance of the aircraft. Once selected, they are then readily available if the need for an alternate arises anywhere along the route of flight.

Operations Facilities

Loaded with your weather information, you're then ready to visit the operations office for a check of the radio facilities along the proposed route of flight. The Radio Facility Chart, AN 08-15-1, is your best source of this information. Your destination should be checked for length of runways, airport elevation, type of fuel available and jet starting unit. You should also check the status of radio range, GCA or ILAS, homing facilities, VHF/DF homer and obstructions (found in Pilot's Handbooks).

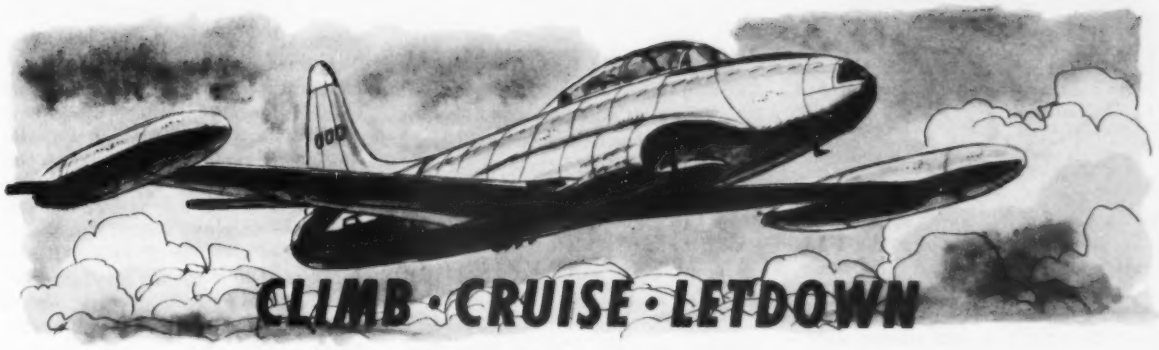
This information should be collected for each alternate airport. A check of NOTAMS will give the latest information pertaining to radio facilities and airport condition.

When you've completed your check of weather, radio facilities and airport condition, then make the final plans on your route of flight. If maps are used to plan the route, be sure to check all radio facilities against the Radio Facility Charts, NOTAMS and The Airman's Guide.

At this point in your planning you are a fountain of information, but oddly enough the time consumed in gaining this information is not prohibitive. About thirty minutes should give you the complete picture. Starting in the weather office and then working into operations eliminates those many trips back and forth picking up information which could have been gained in one chat with the forecaster. Then too, if one piece of the information which you have helps to avoid walking home from your flight, you'll have saved one whale of a lot of time in the long run.

Forecasting your fuel requirements and flight time is your next step. Using the proper techniques, it is possible to forecast fuel requirements within ten gallons and flight time within two minutes.

Knowing the exact amount of fuel aboard and following the checklist are musts for good flight planning.



CLIMB · CRUISE · LETDOWN

NORMALLY, jet aircraft climb to high altitudes (25,000 to 50,000 feet) at high indicated airspeeds (200 to 450 knots). Naturally, this means a large quantity of fuel is burned in the climb and a considerable distance over the ground is covered before reaching cruising altitude.

Because of these facts, the climb assumes extreme importance in jet flight planning. In fact it's possible to deal yourself right out of the card game in the climb, by neglecting to figure how much fuel you'll have in your "poke" when you hit the cold blue yonder.

The rate of climb will affect the time for the climb and the fuel used during the climb. The most important factor determining the rate of climb is the temperature of the air through which the aircraft is climbing. The higher the temperature, the lower the rate of climb for any given power setting and altitude.

The distance flown during the climb will depend on the true airspeed, time spent in the climb and wind velocities at the various altitudes through which the aircraft passes.

It's obvious, even at this point, that we need some performance data, rates of climb for instance, on a certain type aircraft before we can go much further. The Pilots Flight Operating Instructions for your particular aircraft will give you the information you need. The examples in this article are based on flight data for the T-33A, but the procedures are applicable to any jet aircraft when performance data for that particular aircraft is substituted.

Climb data that we need are found in the climb chart of the Flight Operating Instructions. Typical climb charts are on page 5. Data contained in these climb charts are based on a standard day. A standard day is the slipstick driver's answer to the average man, "there hardly ain't no sech animal." A standard day is a day at 40° latitude when the temperature is 59° F., pressure is 29.92 and the adiabatic lapse rate is 3.55° per thousand feet.

Since these climb data are based on such a day, most climbs will have to be computed for the actual flight conditions existing at the time of the climb. The climb chart carries a note which explains how such computation is carried out: "To correct Rate of Climb values for air temperature different from standard day temperature, subtract 35 feet per minute from the Rate of Climb for every degree Fahrenheit above standard day temperature for both clean configuration and drop tank configuration." Uh huh!

You'll also note, in Fig. 1, that the climb chart gives a rate of climb for an altitude, the time to climb each 5000 feet, the fuel used to each 5000-foot level and the calibrated airspeed (CAS) for the climb.

If the chart is to be used properly, it should be clarified. The rate of climb shown opposite each 5000-foot level is the rate of climb at the given CAS as the aircraft passes through that level and not the average rate of climb through 5000 feet of altitude.

For example, on the chart opposite the 5000-foot level, the rate of climb is 3350 fpm and the time is 1.4 minutes. This doesn't mean that a rate of climb of 3350 fpm was flown for 1.4 minutes. It means that at the 5000-foot level, the rate of climb was 3350 fpm and the elapsed time from sea level to 5000 feet was 1.4 minutes.

To determine the approximate average rate of climb to 5000 feet, just take the average of the rates of climb at sea level (3850 fpm) and at 5000 feet (3350 fpm). Thus, the approximate average rate of climb to 5000 feet is established at 3600 fpm on a standard day.

By using the average rate of climb on a standard day and applying a temperature correction, the corrected rate of climb can be established. Once we've got the corrected rate of climb we're in business, since we can then compute the elapsed time, fuel used to climb each 5000 feet, and the distance flown during the climb.

Temperatures

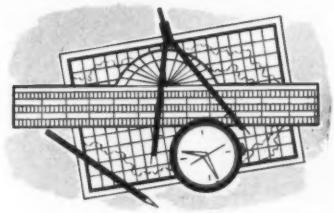
Somebody mentioned temperatures. The adiabatic chart gives the standard day temperatures for all altitudes. It also gives the actual temperatures at all altitudes. The weatherman will be of great assistance in helping you to get actual temperatures from the chart.

To figure our way from sea level to 5000 feet, we first get the average standard day temperature between these levels, i.e., the temperature at 2500 feet. Then here's what happens.

The standard day temperature at 2500 feet is 50°F. Let's assume that the adiabatic chart shows the actual temperature at 2500 feet to be 80°F. This is 30° warmer than the temperature for a standard day at that altitude. As instructed by the tech order, we multiply the difference in temperature (30°) by 35 fpm, and find that the corrected rate of climb will be 1050 fpm less than on a standard day or 2550 fpm (3600 minus 1050 fpm).

Once we have corrected rate of climb, it's a simple matter to set up a ratio on the E6B Computer between the standard day rate of climb and the corrected rate of climb. Set 2550 on the inner scale opposite 3600 on the outer scale, then opposite 1.4 on the inner scale (time for the climb on a standard day) read 2.0 on the outer scale. This is the time in minutes required to climb to 5000 feet at the corrected rate of climb. Without changing the computer setting, read the corrected fuel for the climb on the outer scale opposite 20 on the inner scale (gallons of fuel necessary for climb on standard day). In this case, 28 gallons.

Now, notice on the climb chart



that a CAS of 275 knots at sea level is indicated. On an average, the T-33 requires two minutes and 30 gallons of fuel for takeoff and acceleration to climbing airspeed (270 knots CAS). Since the climb is not started until that CAS is reached, we tack two minutes and 30 gallons to our previous findings. Consequently, the aircraft would pass through the 5000 foot level 4.0 minutes after takeoff roll was started and would have burned 58 gallons.

Now, how far have we flown? We started on the deck at 275 knots. As we pass through the 5000-foot level our calibrated airspeed as shown on the climb chart should be 265 knots. Therefore, we have held an average CAS of 270 knots from sea level to 5000 feet. Using this average CAS, the average temperature and the average altitude (2500 feet), we compute our true airspeed.

Use Winds

Use the forecast winds at 2500 feet and apply them to the TAS, using the wind face of the computer. This will give you the groundspeed and the wind correction angle to 5000 feet. In some cases the wind velocity and/or the true airspeed is too high to be used on the wind face of the computer unless divided by two or three. Be sure to divide both by the same number and also be sure to multiply your result by the same number. Your wind correction angle need not be multiplied as it will remain constant.

When you have your groundspeed, multiply it by the corrected time for the climb (2.0 minutes) and compute the distance flown in the actual climb. To this distance add three miles, the distance flown in accelerating to 275 knots CAS. The result is the distance which the aircraft will be from takeoff point when passing through the 5000-foot level.

Using the same method, you can compute the rate of climb, time, fuel and distance flown for each 5000 feet up to cruising altitude, and enter them on an appropriate log. Add the times required for each 5000 feet of climb to get the total time for climb to cruising altitude.

In like manner, the fuel used and distance flown during the climb can be ascertained. A typical flight log in the summer in southeastern United States would indicate the following data: time to climb to 35,000 feet—30.2 minutes; fuel consumed to 35,000 feet—240 gallons; distance flown in the climb—197.4 miles.

This method of computing corrected climb data is basically sound and is valuable in training pilots in basic theory of jet cruise control. However, the time necessary to correct the climb data makes it impractical for everyday use.

For normal use in correcting climb data, a Climb Compensation Chart should be compiled for the specific type of jet aircraft being flown. Such a chart is constructed by computing the corrected rate of climb, time necessary to climb, fuel to be used and true airspeed for each 5000 feet of climb for various temperatures normally found at the different altitude levels.

The chart is based on the average temperature and the average rate of climb for each specific 5000 feet of altitude on a standard day. For example, the rate of climb used as the basis for the climb from sea level to 5000 feet is the average of the sea level rate of climb (3850 fpm) and the rate of climb at 5000 feet (3350 fpm) or 3600 fpm, on a standard day. You can compute the average rate of climb for the various average altitudes (2500, 7500, etc.) on a standard day for each 5000 feet of climb listed in the same way.

Centigrade temperatures should be used in compiling the chart since the temperatures received from the forecaster are normally in Centigrade. For each degree Centigrade that the temperature is above or below the standard temperature for that altitude, 63 feet per minute should be subtracted from or added to the average rate of climb for a standard day. This results in a corrected rate of climb. This corrected rate of climb can be used in turn to compute the corrected time and fuel for the climb through each 5000 feet of altitude.

To use the Climb Compensation Chart, the pilot has only to get the average temperatures in degrees Centigrade and the winds aloft for each 5000-foot increment of the climb, using surface 2500, 7500, 12,500-foot levels, etc. This takes about five minutes in the forecaster's den. Then whip out the chart and opposite the applicable level find the temperature. Immediately below the temperature, read off corrected rate of climb, corrected time, fuel to be used and true airspeed. That's more like it, isn't it?

If the temperature you have is not on the chart at the applicable level,

TAKE-OFF SUMMARY

Airplane Model(s) T-33A — (Feet) — Engine Model(s) J33-A-23 or -35

70% (31.5° FLAPS, HARD SURFACE RUNWAY)

CONFIGURATION AND GROSS WEIGHT	PRESS. ALT. (FEET)	−5 Degrees Centigrade ZERO WIND Ground Run	−5 Degrees Centigrade ZERO WIND Clear 50 Ft	−5 Degrees Centigrade 30 KNOT WIND Ground Run	−5 Degrees Centigrade 30 KNOT WIND Clear 50 Ft	+15 Degrees Centigrade ZERO WIND Ground Run	+15 Degrees Centigrade ZERO WIND Clear 50 Ft	+15 Degrees Centigrade 30 KNOT WIND Ground Run	+15 Degrees Centigrade 30 KNOT WIND Clear 50 Ft	+35 Degrees Centigrade ZERO WIND Ground Run	+35 Degrees Centigrade ZERO WIND Clear 50 Ft	+35 Degrees Centigrade 30 KNOT WIND Ground Run	+35 Degrees Centigrade 30 KNOT WIND Clear 50 Ft	+55 Degrees Centigrade ZERO WIND Ground Run	+55 Degrees Centigrade ZERO WIND Clear 50 Ft	+55 Degrees Centigrade 30 KNOT WIND Ground Run	+55 Degrees Centigrade 30 KNOT WIND Clear 50 Ft
(Two 230 gal.	S.L.	2575	3825	1400	2375	3200	4925	1825	3100	4100	6275	2375	4025	5150	7900	3025	5125
tip tanks)	1000	2750	4150	1575	2600	3500	5350	2025	3400	4475	6850	2650	4500	5675	8675	3425	5700
15,500 Lb.	2000	2975	4525	1750	2850	3810	5825	2225	3750	4900	7475	2975	5025	6250	9525	3825	6375
Without	3000	3250	4925	1925	3150	4150	6350	2475	4150	5350	8175	3275	5575	6850	10450	4250	7125
Water	4000	3550	5350	2100	3475	4525	6900	2725	4550	5850	8925	3600	6075	7525	11450	4650	7875
Injection	5000	3825	5825	2275	3800	4925	7500	2975	5000	6350	9750	3950	6500	8225	12500	5150	8575
(Two 230 gal.	S.L.	2100	3250	1175	2050	2650	4200	1500	2675	3350	5375	1950	3500	4200	6800	2475	4450
tip tanks)	1000	2275	3550	1300	2275	2900	4575	1675	3025	3675	5875	2200	3900	4600	7450	2775	5125
15,500 Lb.	2000	2475	3875	1425	2475	3150	5000	1875	3325	4025	6425	2425	4325	5025	8150	3075	5525
With	3000	2700	4225	1550	2700	3425	5475	2050	3625	4400	7050	2675	4750	5500	8950	3400	6150
Water	4000	2925	4600	1675	2950	3750	5975	2250	3950	4775	7700	2925	5225	6050	9825	3725	6750
Injection	5000	3175	4975	1850	3250	4050	6500	2425	4300	5200	8425	3175	5700	6625	10775	4075	7400

a little interpolation may be necessary. From this point the flight planning procedure is the same as that previously explained for computing groundspeed, drift correction angle and the distance flown during the climb.

The big problem is putting the finger on the guy in the outfit who's going to make up the chart. If there's a man with a head full of figures—numerals, that is—he's a good bet. But watch him pretty closely. Things get a little binding about the 35,000-foot level.

Other Factors

There are a few other points that should be kept in mind when working with climb computations. Remember, altitude is expressed in "pressure altitude feet." This means that the data on the chart are based on pressure altitudes and that pressure altitude variation should be considered.

If not computed, a very small error will result; however, if the pressure altitude variation is 600 feet or greater, it should be computed. This means that the corrected rate of climb, fuel and distance must be computed for 600 feet of climb, using the corrected set level rate of climb before computing the data for the first 5000 feet of climb.

Another factor that must be considered in computing climb data is the altitude of the field from which the flight is to be made. When taking off from an airfield at an altitude other than zero feet, you must adjust the climb data to compensate for this difference. For example, assume the flight is to originate from Lowry AFB, where the field elevation is 5420 feet. Obviously the first 5000-foot increment to be computed will be the level from 5000 to 10,000 feet, but it is necessary to subtract the time, fuel and distance that would be necessary to climb 420 feet.

During the climb, the airspeed should be changed smoothly and gradually. For instance, the climb from sea level is started at 275 knots CAS and is gradually changed so that, as the aircraft passes through the 5000-foot level, the airspeed is 265 knots CAS. The airspeed is changed throughout the climb in this manner.

Flight En Route

En route flight planning is the planning of that portion of the flight at cruising altitude from the point of level-off until the aircraft is over the destination or to the point at which the descent is begun, whichever is sooner.

Normally, the best altitude at which to cruise will be one which gives the best cruising range when the wind, fuel consumption and true airspeed factors are considered. To explain the factors involved in determining best cruising altitude, let's look at the following example:

Assume the data computed for the climb indicated that a T-33 aircraft would have 500 gallons of fuel remaining on reaching 35,000 feet. Also, assume a tailwind of 80 knots at 35,000 feet and a tailwind of 40 knots at 40,000 feet, with standard day temperatures at both altitudes.

At first, it appears that 35,000 feet would be the best cruising altitude. However, the final selection of the cruising altitude must be made by reference to the Flight Operating Instruction Chart in the Tech Order for the aircraft.

On this chart we find that the best cruising power setting for an 80-knot tailwind at 35,000 feet gives

MAX POWER CLIMB CHART

Airplane Model(s): T-33A
100% RPM
NACA STANDARD DAY
CONFIGURATION: Two 230 Gal. Tip Tanks
GROSS WEIGHT: 15,100 Lb.
Engine Model(s): J33-A-23 or -35

RATE OF CLIMB	FROM SEA LEVEL Distance	Time	Fuel (1)	CAS (Knots)	PRESSURE ALTITUDE FEET
3850	0	0	30	275	Sea Level
3350	6	1.4	50	265	5,000
2850	14	3.0	70	255	10,000
2400	23	4.8	90	245	15,000
1950	35	7.2	111	235	20,000
1500	50	10.0	134	225	25,000
1100	71	13.8	160	215	30,000
750	103	19.1	189	205	35,000
					40,000
					45,000

NORMAL POWER CLIMB CHART

96% RPM
NACA STANDARD DAY

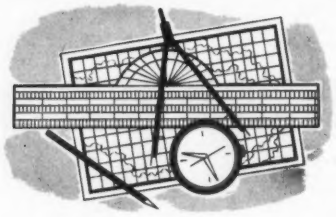
2950	0	0	30 (1)	275	Sea Level
2500	8	1.8	52	265	5,000
2150	18	4.0	73	255	10,000
1750	31	6.5	96	245	15,000
1350	48	9.8	120	235	20,000
950	71	14.1	147	225	25,000
650	105	20.2	179	215	30,000
350	165	30.4	227	205	35,000
					40,000
					45,000

NOTE: (1) Warm-up and take-off allowance

MAX RANGE SUMMARY

Airplane Model(s): T-33A
Engine Model(s): J33-A-23 or -35
NACA STANDARD DAY

CONFIGURATION: Two 230 Gal. Tip Tanks GROSS WEIGHT: 15,100 Lb.				PRESSURE ALTITUDE (FEET)	CONFIGURATION: Two 230 Gal. Tip Tanks GROSS WEIGHT: 12,100 Lb.			
% Rpm	N. MI/Gal	Mach No.	CAS (Kts)		CAS (Kts)	Mach No.	N. MI/Gal	% Rpm
84	.634	.46	304	SEA LEVEL	275	.42	.673	79
85	.733	.48	291	5,000	265	.44	.788	80
86	.857	.51	281	10,000	254	.46	.930	81
87	1.009	.53	265	15,000	246	.49	1.090	83
90	1.134	.58	264	20,000	235	.52	1.256	85
91	1.281	.59	248	25,000	228	.54	1.427	87
93	1.442	.64	239	30,000	222	.60	1.625	89
96	1.548	.68	227	35,000	209	.63	1.832	91
				40,000				
				45,000				
				50,000				



power setting with a 40-knot tailwind at 40,000 feet gives a range factor of 1.1 with a groundspeed of 427 knots. By referring to the data opposite the 500-gallon fuel level under the 35,000-foot column on the chart, you find that under a no wind condition, the maximum range of the aircraft is 871 nautical miles by remaining at 35,000 feet; however, climbing to 40,000 feet with the same wind condition increases the maximum range to 964 nautical miles. The maximum range with an 80 knot tailwind at 35,000 feet is found by multiplying the maximum range under a no wind condition, 871 nautical miles, by the range factor (1.2); 871x1.2= 1045 nautical miles maximum range.

Computing the maximum range for a 40 knot tailwind at 40,000 feet in a like manner you find it to be 1060 nautical miles (964 x 1.1 = 1060). Therefore, it can be seen that the maximum range is increased by 15 nautical miles by climbing to a cruising altitude of 40,000 feet with the above wind conditions.

The Flight Operating Instruction Chart provides for the descent to sea level and landing with a fuel reserve of 50 gallons. The chart for the specific engine model used in the aircraft should be used and the chart should be checked closely to determine whether or not an allowance was made for reserve fuel on landing.

The best power setting to produce the greatest range for the wind condition and altitude is shown on the Flight Operating Instruction Chart as is the CAS and groundspeed to be expected from the power setting. It should be noted that the indicated airspeed is normally higher than the CAS as is indicated on the Airspeed Correction Table in the Technical Order for the aircraft.

Fuel Weight

At the beginning of the flight, the CAS will normally be lower than shown on the chart for the power setting because of the weight of the fuel. As the gross weight of the aircraft diminishes with the use of fuel, the airspeed increases, until near the end of the flight the airspeed will be higher than that shown for the power setting.

The altitudes on the Flight Operating Instruction Chart for computed fuel consumption, calibrated airspeed and groundspeed are for a standard day on which pressure altitude, indicated altitude and density altitude are one and the same. Aircraft performance is based on density altitude, therefore the pilot must determine and fly the indicated altitude necessary to make good the selected density altitude. This is accomplished on the E6B computer, as follows:

Assume the density altitude of 30,000 feet has been selected as the desired cruising altitude and that a temperature of -25°C. is shown on the adiabatic chart at 30,000 feet. On the altitude compensation scale of the computer, set -25°C. opposite 30,000 feet. Then, opposite 30 on the outer scale (miles scale) read the indicated altitude (27,700) to be flown to make good a density altitude of 30,000 feet. Therefore, an indicated altitude of 27,700 feet must be maintained in order that the en route cruise control computations for a density altitude of 30,000 feet will be correct, and the climb data should be adjusted to compensate for the difference in climb.

The en route groundspeed and drift correction angle is determined on the E6B computer by applying the forecast wind direction and velocity to the true airspeed. In-flight ETA's

Jet Letdowns

The primary purpose in the establishment of the jet letdowns was to permit jet aircraft to accomplish penetration and standard instrument approaches with the least possible delay in time and the minimum number of turns.

These jet penetration procedures are established so as to provide the least interference with conventional type aircraft, and to provide for the accomplishment of jet letdowns when conventional aircraft are held on the primary fix where the jet aircraft is executing letdown. In almost all cases the low cone altitude and the procedure turn altitude published in the jet instrument procedure are identical to the standard range approach.

★ *Initial penetration altitude.* The altitude at which aircraft crosses radio facility for beginning penetration procedures. This altitude will be established for each procedure and will normally be specified as 20,000 ft MSL.

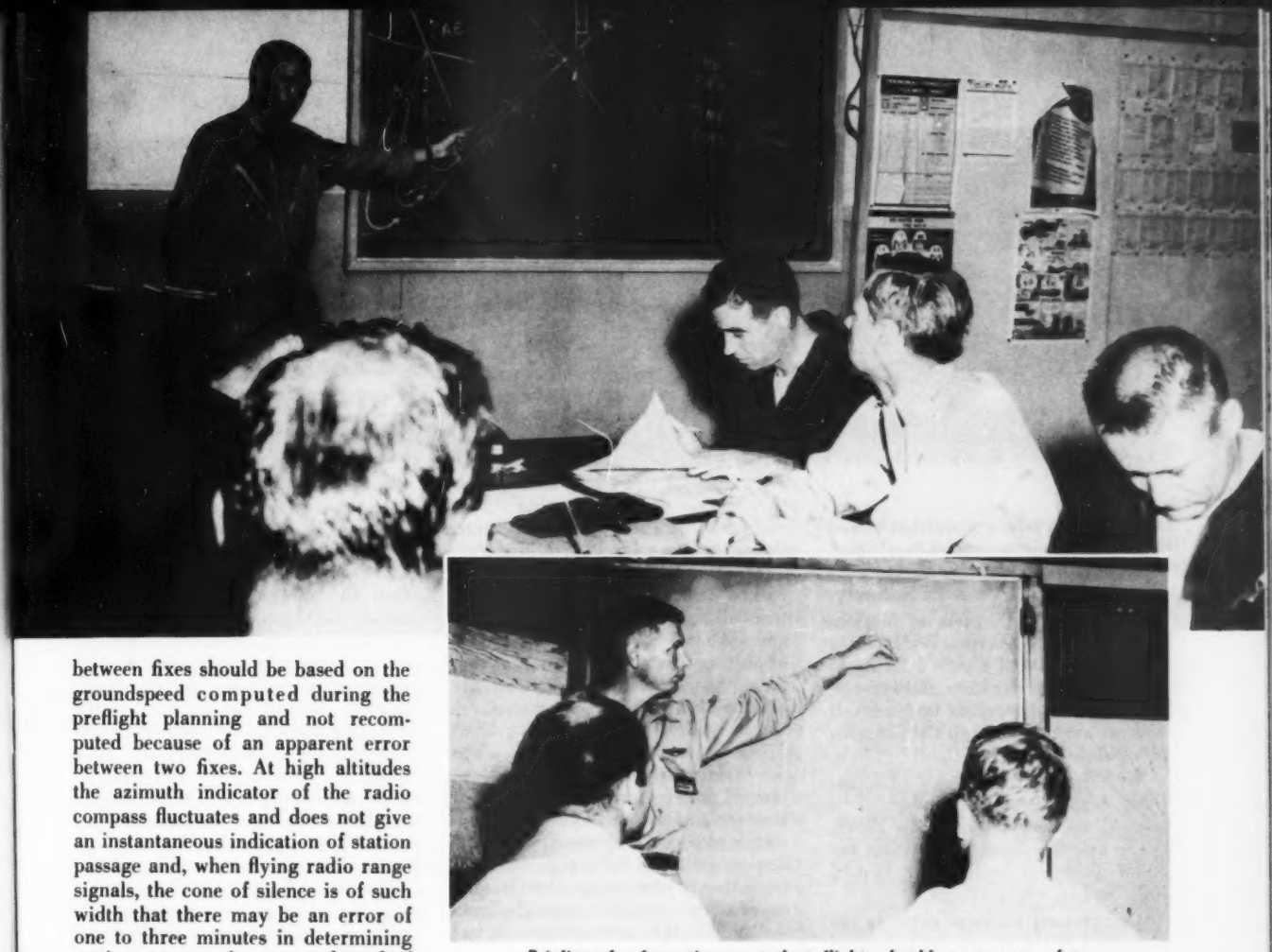
★ *Penetration turn.* A one and one-half degree per second turn is made during the jet penetration procedure to return the aircraft to an inbound heading to the radio facility being used for the penetration. The penetration turn is normally a flat turn, however, if a descending turn is used, indication will be given in the procedure.

★ *Minimum penetration altitude.* The minimum altitude for the jet penetration procedure turn to an airport will be the initial approach altitude for the standard instrument approach procedure.

★ *Initial approach altitude.* The initial approach altitude will normally be as shown for the standard instrument approach procedure. Where no initial approach altitudes have been established, a clearance of at least 1,000 feet above all obstructions within a radius of ten miles of the radio facility and ten miles to either side of all penetration courses within an open quadrant for a distance of 40 miles from the radio facility must be provided except in mountainous areas. In all parts of the United States and Canada designated as mountainous areas a clearance of at least 2000 feet must be provided.

★ *Procedure turn.* Will be executed as shown in the standard instrument letdown criteria.

★ *Emergency altitude.* An altitude which will clear all obstructions within a radius of 100 nautical miles of the radio facility by 1000 feet except in mountainous areas. In mountainous areas the clearance will be 2000 feet.



Briefings for formation or student flights should cover every phase from runway length to final approaches.

between fixes should be based on the groundspeed computed during the preflight planning and not recomputed because of an apparent error between two fixes. At high altitudes the azimuth indicator of the radio compass fluctuates and does not give an instantaneous indication of station passage and, when flying radio range signals, the cone of silence is of such width that there may be an error of one to three minutes in determining station passage. At a groundspeed of 478 knots with check points 174 nautical miles apart, an error in time of this size would mean an apparent error in groundspeed of 56 knots. Hence, the same method of determining station passage should be used for all check points, i.e., if the movement of the azimuth indicator through the 90 or 270-degree point is used for the time of station passage over the radio aid, it should be used in the same manner over subsequent radio aids. In general, through experience, it has been found that the groundspeed computed for cruising altitude during the preflight planning should be used in flight for determining all ETA's.

Constant pressure and temperature levels vary in actual height above sea level. Since the true altitude for a given indicated altitude changes with any changes in temperature or pressure, the aircraft will climb or descend while a constant indicated altitude is being maintained. These climbs or descents may cause the indicated airspeed to change by as much as eight knots.

In order to attain maximum efficiency from an aircraft that derives some engine efficiency from a ram intake, climb above the cruising altitude (200 to 300 feet for the T-33), then descend at approximately 200 fpm to the desired altitude, allowing the indicated airspeed to build up to or above that desired for cruising before reducing the power from the climbing power setting. Fly the aircraft smoothly and maintain the desired altitude as nearly constant as possible.

DESCENT CHART

Airplane Model(s) T-33A — NACA STANDARD DAY — Engine Model(s) J33-A-23 or -35

CONFIGURATION: Two 230 Gal. Tip Tanks
GROSS WEIGHT: 10,600

RATE OF DESCENT	APPROXIMATE TO SEA LEVEL Dist. N.M.	Time	Fuel	CAS (Knots)	PRESSURE ALTITUDE FEET
1150	74.5	12.4	23	174	40,000
1750	54.5	8.9	18	200	35,000
2400	40	6.4	14	226	30,000
3200	29.5	4.7	10	248	25,000
4100	20.8	3.4	8	274	20,000
5150	13.9	2.2	5	305	15,000
6300	8.7	1.4	3	335	10,000
7600	4.3	0.6	1	365	5,000
9000	0	0	0	395	Sea Level

PENETRATION & LOW APPROACH

JUDGMENT is a word that comes in two sizes — good and bad. Pilots have been exercising both sizes in airplanes for a half century.

Until the arrival of jets on the aviation scene, only a certain few types of flights really taxed a pilot's ability to analyze a flight situation and exercise the proper judgment to take himself and his aircraft through the situation successfully.

With jets the frequency of situations demanding good judgment is stepped up considerably. The climb, cruise and the descent all present peculiar problems calling for sound judgment in any jet flight.

The greatest of these three is the descent. For the success or failure of many jet flights will depend solely on the judgment exercised in planning a descent from cruising altitude, whether conditions are VFR or IFR.

The Descent Chart in the pilot's Flight Operating Instructions (see Fig. 3) contains the data necessary to plan a descent with the most favorable range-fuel ratio for your particular aircraft. The chart indicates the distance from destination at which a descent should be started, under a no-wind condition. It also shows the proper airspeeds to be used and the fuel which will be consumed in the descent, together with prescribed rates of descent. The data on the chart are based on a standard day with the power set at idle and the aircraft "clean," unless otherwise stated. The chart shown in the illustration contains data applicable to the T-33 aircraft.

To illustrate the use of the chart, assume a cruising altitude of 35,000 feet on a standard day in a T-33. With the throttle in idle and the aircraft "clean," the initial rate of descent will be 1750 fpm at 200 knots (CAS). The letdown should be started 54.5 nautical miles from a destination with a sea level elevation.

The time required for the descent will be 8.9 minutes and the fuel used will be 18 gallons. The rate of descent and CAS are increased with the loss of altitude as shown on the chart, and these changes should be constant and smooth throughout the descent.

IFR Technique

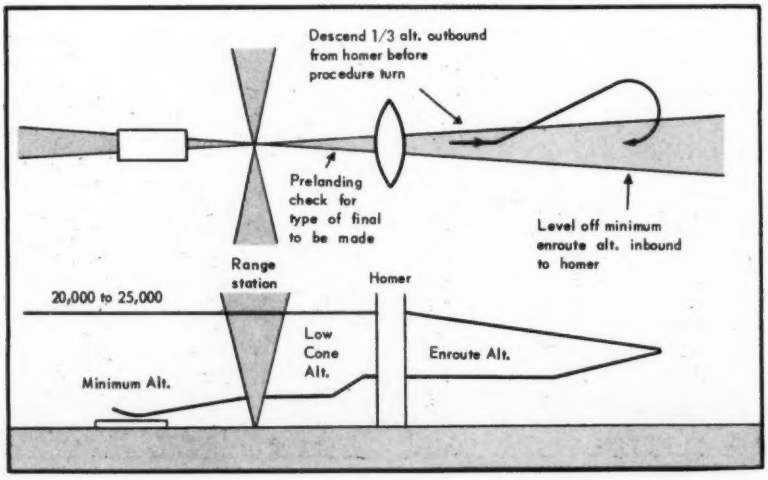
The Descent Chart just about whips the problem in a VFR descent. However, if the destination is IFR, other factors must be considered in planning a descent at destination. If the destination is IFR, a plan must be made for a penetration that is safe, expeditious, positive, can be controlled by the appropriate control agency and which places the aircraft in the most advantageous position to make the type of low approach contemplated.

Experience has proven that it is very poor judgment to descend below 20,000 feet en route to a destination that is IFR, even if an expedited approach is assured. For example:

A jet reports over the fix at 10,000 feet. The pilot is advised to hold because ARTC has an aircraft at a lower altitude in the vicinity that has not reported over a designated fix, or Approach Control has cleared an aircraft to take off and the pilot of the departing aircraft has forgotten to report passing a designated fix. As a result, the incoming jet pilot must declare an emergency and descend through altitudes without positive separation. Another illustration: A severe rainstorm has moved over the field and GCA cannot pick up the jet fighter, which has approximately 1/6th the reflecting area of the F-51. The ceiling and visibility are too low for a range approach and the jet, at 10,000 feet, does not have sufficient fuel to climb out and go to the alternate. The result is obvious.

If, however, the pilot remains at a minimum of 20,000 feet until reach-

Fig. 1


Descend 1/3 alt. outbound from homer before procedure turn
Prelanding check for type of final to be made
Level off minimum enroute alt. inbound to homer
Range station
Homer
20,000 to 25,000
Low Cone Alt.
Enroute Alt.
Minimum Alt.

ing the fix and receiving clearance, he is then in a position to make an approach within his capabilities or to proceed to an alternate.

Twenty to twenty-five thousand feet is a good altitude range in which to report over your destination fix. From this altitude your time for penetration is not excessive and you have altitude working for you in the event you must proceed to an alternate. If cruising at altitudes higher than these, use the Descent Chart in planning a descent to arrive over the fix at the desired altitude. By subtracting the figures opposite the new desired altitude on the chart from those opposite the cruising altitude, you can determine the fuel, time and distance for the descent.

For example, a T-33 aircraft cruising at 40,000 feet is cleared to cross the destination fix at 20,000 feet. Under a no wind condition, the chart indicates that the descent should be started 53.7 nautical miles from the fix; the descent will take 9.0 minutes, and 15 gallons of fuel will be consumed.

When the fix is reached, there are several methods of making a penetration, depending upon traffic conditions, terrain, fixes and approach aids available. It's a good practice to simulate penetrations in VFR weather from altitudes between 20,000 and 25,000 feet to determine (1) the amount of fuel consumed during the penetration and low approach, (2) the total elapsed time for the descent and approach and (3) the ground pattern covered by the aircraft while making various types of penetrations.

There are many types of penetrations that can be successfully accomplished. Some of the various penetration and low approach procedures are described and illustrated on the following pages. Although the airspeeds, power settings and techniques are those specifically applicable to the T-33, corresponding airspeeds in knots can be used in other jet fighters.

Types of Approaches

★ *Approach Using a Homing Facility on the Approach Bearing:* (Fig. #1.)

This type penetration and approach is ideal for jets when the homing facility is located on the approach leg of the range so that the low cone altitude provides terrain clearance for an aircraft descending inbound from the homing facility to the low cone.

The penetration is made from the homing facility, on the reciprocal of the approach bearing. Lose one-half the altitude before starting the procedure turn. Any airspeed, gear, flap and power combination can be used during the penetration, but the indicated airspeed must be held constant and the rate of descent must not be permitted to decrease. The aircraft must remain within reception distance of the radio aid and sufficient power must be used (1) so that the pilot will get a reasonable amount of acceleration from the engine if needed and (2) so that sufficient heat for the defrosters and anti-icers will be assured.

The recommended conditions for the F-80C or T-33 are 152 knots TAS, full flaps, dive brakes, gear down and 65 per cent power.

After the procedure turn is completed, the level off is started 1000 feet (2000 feet in formation) above the minimum en route altitude for the range leg. The level off is accomplished by retracting the wing flaps completely without hesitation, raising the landing gear, and when 200 feet above the desired altitude, retracting the dive brakes. Research has shown that this is also the most satisfactory sequence for instrument level-offs. The aircraft then proceeds to the homing facility at the minimum en route altitude at a power setting of 65 per cent. When over the fix, make the pre-landing check in preparation for the final approach, whether it be GCA, ILAS, radio range or a combination of these approaches.

If for any reason the aircraft (T-33) should have to hold at a low altitude, the power should be adjusted to maintain a fuel pressure of 60 psi. Sixty psi fuel pressure usually can be held at 65 per cent rpm and

Fig. II

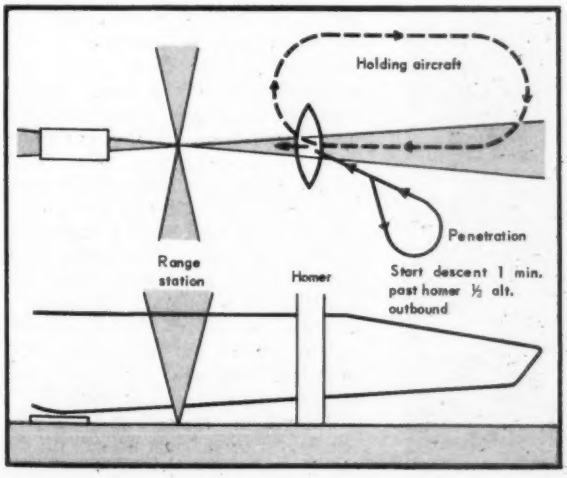
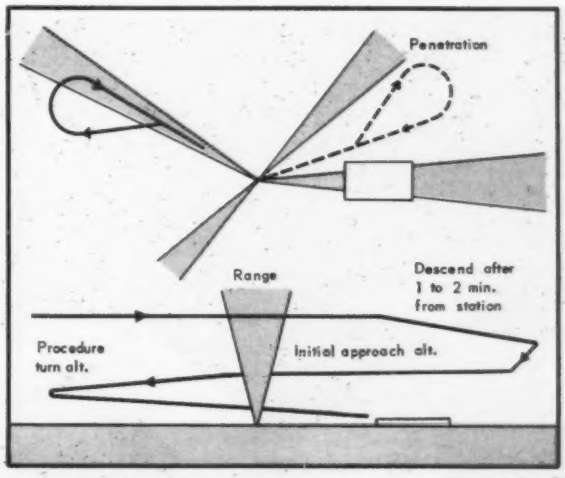
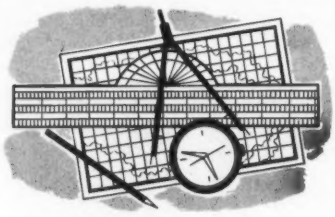


Fig. III





a fuel consumption rate of approximately four gallons per minute results. Sixty-five per cent rpm is sufficient power to maintain airspeed and altitude in a turn using up to a 30-degree angle of bank with a fuel load of 200 gallons or less.

If a GCA or ILAS approach is used, lower gear, dive brakes and 35 to 60 per cent wing flaps on final approach and reduce the indicated airspeed to 130 knots. Add five knots per hour to the above airspeeds for each 100 gallons of fuel remaining in excess of 200 gallons. Descend to the altitude which will intercept the glidepath at the proper point. Then adjust the power to maintain altitude and airspeed. The amount of fuel used in this type penetration and low approach for the T-33 is 65 to 70 gallons.

★ *Straight-In Approach*

If a straight-in range approach is made, lower the gear after passing the fix inbound, descend to low cone altitude holding 174 knots. Upon reaching the low cone altitude, level off, permit the airspeed to drop off to 139 knots, then add power to 74 per cent to maintain this airspeed. The total fuel used in this type penetration and low approach from 20,000 feet in the T-33 is 60 to 65 gallons and the total time for the approach should be between 10 and 14 minutes.

★ *Approach Using Radio Range Only (No Lower Traffic).*

Cross the radio range station at 20,000 to 25,000. Proceed out the range leg opposite the procedure turn leg. Lose one-half the altitude outbound as previously outlined. Return to the range station at the en route altitude of the leg you have just flown or at the procedure turn altitude, whichever is higher. Upon crossing the range station, execute a normal range approach as published for that station. Proceed from the station out the procedure turn leg not over one minute and thirty seconds at approximately 174 knots (65 per cent in T-33) and descend to procedure turn altitude with dive brakes down.

Upon reaching procedure turn altitude, raise dive brakes. Execute the procedure turn, and when on course inbound, lower the gear, hold 174 knots and descend to low cone altitude. At low cone altitude, level off and permit the airspeed to drop to 139 knots, then add power to about 74 per cent to maintain 139 knots. Use dive brakes to descend from low cone altitude to minimum altitude, retracting them after reaching that altitude. This approach will take 60 to 68 gallons of fuel and 15 to 17 minutes total time. It can be made with a formation.

★ *Approach in an Open Quadrant Using Homing Facility (With Traffic Holding at the Homing Facility, Fig. #2).*

Proceed to the homing facility at 20,000 to 25,000 feet. Upon passing the fix, steer 45 degrees off the range leg into the quadrant which does not contain the stack. If there are no aircraft holding within 5000 feet below your aircraft, a descent can be started immediately. Descend one-half the altitude outbound as described above, continue descending in the procedure turn, return to the homing facility at the assigned altitude and make an approach straight in, GCA, ILAS or radio range.

If the aircraft are within 5000 feet below you, proceed out into the quadrant one minute or more before descending. Then proceed as above. This type of penetration and approach takes 60 to 70 gallons of fuel and approximately 14 to 15 minutes.

★ *Aproach With Traffic On All Legs of the Range and No Homing Facility Available (Fig. #3.)*

In the event through traffic, holding traffic, etc., have all legs of the radio range occupied, proceed as follows: Cross the range station at 20,000 to 25,000 feet and proceed outbound (terrain permitting) on the bisector heading of either of the quadrants which has the landing field located on the range leg separating them.

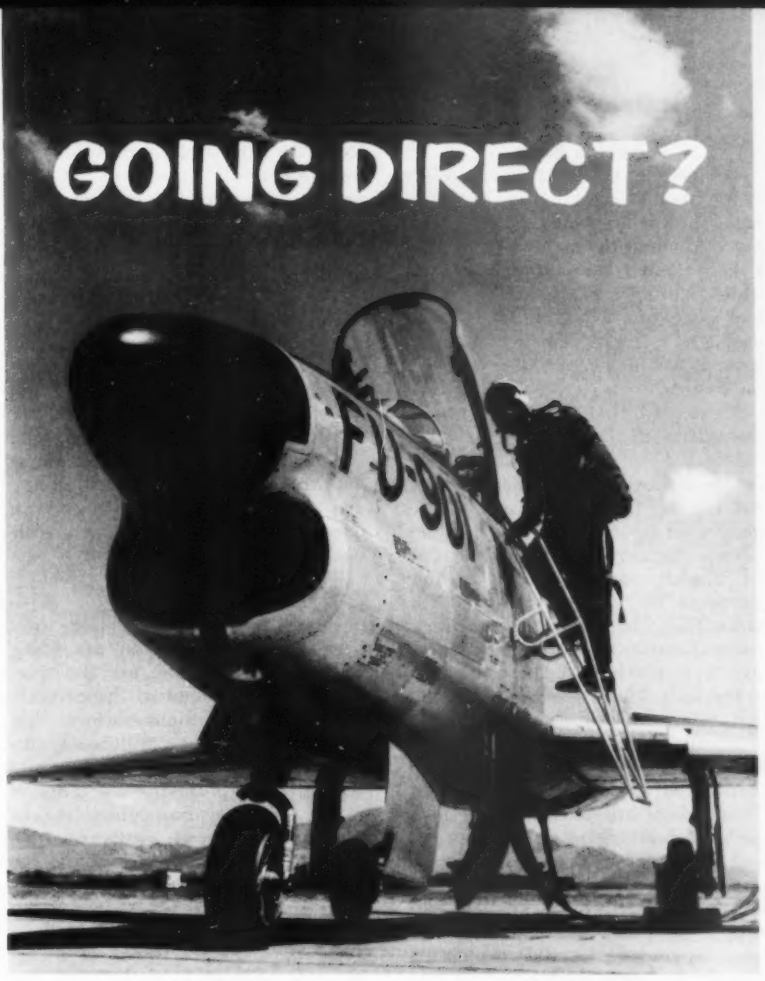
To avoid descending through occupied altitudes on the range leg, level flight is maintained on the outbound bisector heading until clear of the range leg and/or the airway, normally one or two minutes depending on groundspeed. The penetration is made as described above for the radio range approach except, instead of descending on the range leg, the penetration is made in an open quadrant. Return to the range station at an assigned altitude from which a normal range approach, GCA or ILAS can be made. Eighty to ninety gallons of fuel will be consumed and the approach will take 16 to 18 minutes total time.

If a GCA is made using a rectangular pattern after returning to the range station, approximately 110 gallons of fuel will be consumed and 18 to 23 minutes required for the complete letdown from 20,000 feet to touchdown. It's a good idea to request GCA to pick you up inbound upon completion of the procedure turn for a straight-in GCA. With proper planning, a track can be flown from the range station to get in position for a straight-in GCA approach.

These are only a few of the basic types of jet approaches that are available to a pilot in the event a letdown is necessary. As you can see, no one type of penetration fits every situation. Judgment, once again, determines your choice of method.

The old, old method of "Ready or not, here I come" just doesn't fill the bill for jet IFR letdowns. ●

Check the NOTAMS for en route airports as well as for final destination.



. . . fly one heading!

By Capt. John C. Neill

DID you ever hear of a Geostrophic Wind Scale? If you have, the Air Weather Service is looking for you if they haven't already found you. Furthermore, if you have — forget it 'cause I don't know what it is and probably couldn't explain if I did. Don't stop reading now! I go under the theory that if a guy talks long enough, he is bound to say something sooner or later.

You know, I used to think weather forecasters were all a bunch of pessimistic die-hards. They just draw a bunch of red, blue and purple lines all over maps and talk about mixing ratios, isogonic and isothermic lines just to impress or confuse you. I don't let that bother me, no sir-eee! I just pull out that green card when I start toward the Ouija — I mean weather office. Boy, that thing gives you about as much prestige in a weather office as it does in a good hailstorm.

Well, the other day while I was waiting to get some jet-juice, I decided to stroll through and see what evil winds they had brewed between Moody and Chicago. Would you believe it: one of those astrolog--I mean forecasters, had the nerve to ask if he could help me, and all the time I had that green ticket in plain view. Of course I looked around to see if any of my friends were watching before I answered him. You don't think I want to be a disgrace to the Clan of the Green, do you?

Ready To Go

Finally, I told him that I was just about ready to saddle a hot pipe for the Windy City and wondered what kind of breeze was blowing around 40,000. Naturally, he went over to the winds aloft charts, but they were blank, as usual. Immediately, I put on my best ironic smile and was about to tell him that it really didn't matter when he walked over to another chart and motioned me to follow. That suited me fine: "The more rope you give him, the higher he will hang himself."

He took the chart off the board and placed it on top of a table. Now this was OK by me, but then he started getting personal. He asked me what altitude, route and airspeed I was going to fly. I guess I should have turned all eight loose on him at once but I managed to control myself. I finally calmed down enough to tell him in a rather cryptic tone that I was going at 420 knots TAS, 40,000 feet and direct Montgomery, direct Chicago — anybody knows a jet jockey goes direct and does not bother with airways or ADIZ zones.

By the time I had lit a cigarette, blown a couple of smoke rings, and turned to see what he had done with the chart, he started giving me the word just like he knew what it was like flying a "squirt job" at 40,000. He told me to climb on course and fly directly over Maxwell Radio. From Maxwell Radio, he told me to hold 17 degrees of left drift correction and it would put me over O'Hare Airport at Chicago.

Now I know that putting out this kind of info isn't SOP with forecasters, but this man seemed anxious to prove something to me, so I decided to go along with the gag.

I started a fire in the flues and pointing its nose down the runway, I gave throttle. It did not seem like any time had passed before I was at 40,000 and turning over Maxwell. Now the heading from Maxwell to Chicago is about 353 degrees so I held 336 just like the man said.

I knew that I was supposed to go just to the left of Nashville, and just to the right of Terre Haute. Well, I was to the left of Nashville but when I reached Terre Haute, I went to the left of it. When this happened, I knew I had one each weather forecaster dead to rights; however, I decided that I would continue and get a good case against him. You know what? I should have quit while I was ahead. When I turned the "Bird Dog" to the homing beacon located at the outer marker at O'Hare, the needle pointed off to the right about three degrees. About two minutes before I crossed the facility, that needle had moved over until it was pointing straight ahead, i.e., I passed over the station just like he said I would.

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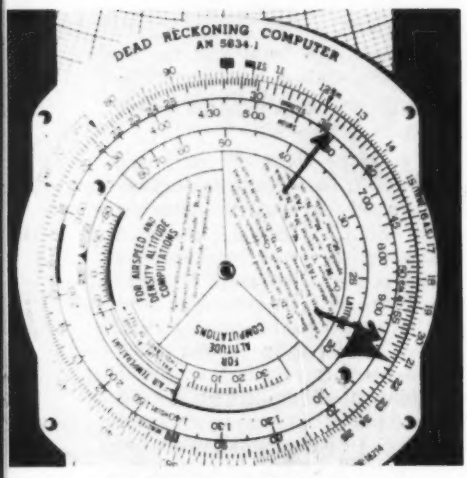


Fig. 1: Here is an E6D setup to get crosswind component of 126 knots.

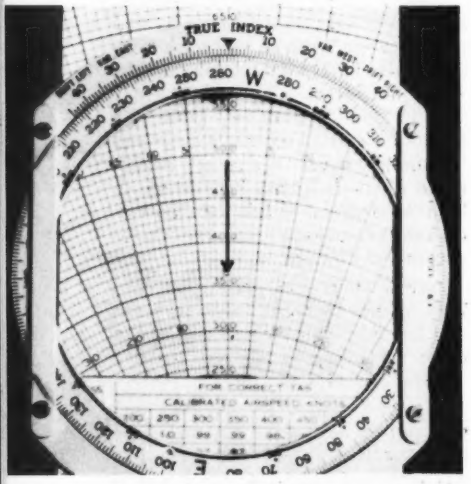


Fig. 2: This is the way you convert the crosswind to obtain the drift angle.

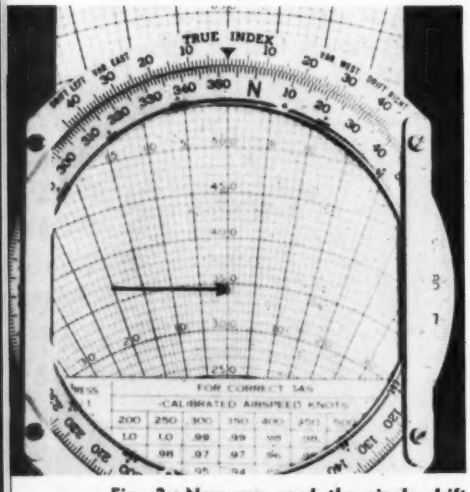


Fig. 3: Now you read the single drift angle at the tip of the wind vector.

Quite a Blow

Believe me, that was quite a blow to morale and it started me to thinking. The weather officer had computed my drift for me so quickly that I had missed the entire operation while lighting a cigarette. Maybe he had something which might even be useful to a "red-faced" jet pilot. At least, it would not hurt to ask about his system.

I did just that when I returned and what I found out was startling! In the first place, I found out that the weather man who had figured out my drift correction was a full-fledged jet pilot as well as a weather officer. Furthermore, he did a tour of combat with the 51st Fighter Group in the Korean fracas. At the same time, he was flying weather reconnaissance and forecasting where they were playing for keeps. He happened to be Major Leon M. Grisham, and was now Assistant Director of Academics, 3550th Training Group, Moody AFB, Georgia. This group consists of the USAF Instrument Pilot School; the Instrument Phase, USAF Aircrew School (Interceptor), and the Jet Transition School.

While I was trying to figure out whether he was a jet jockey that had slipped or a weather man that had been upgraded, he was explaining how he had computed my drift correction — in fact, he explained the process before I knew what was going on. As a result, he had to explain it again! Well, the thing was so simple that I had a hard time understanding it. Nevertheless, I am going to try to tell you how it is done, so here goes!

Somewhere during your checkered career you've probably heard rumor of a relation between windspeed and pressure. Well, it's true. Give a crystal ball gazer several pressure readings and he'll slap them into that "Geostrophic Wind Equation" that we glossed over but lightly at the beginning of this thing and out comes the windspeed.

OK — so you're convinced. But did you know that you too can diddle with this "Geostrophic Wind" thing? The AN 5834-1 Dead Reckoning Computer (E-6D to you) has a scale based on this formula.

How It Works

Here's how it works. Once you have decided where you are going and at what altitude, ask the forecaster for the height of the pressure surface at your flight altitude over the point where you will reach altitude and over destination. Give him a rough guess at the times you expect to be over these two points, and he can crank out some pretty accurate figures. Then you can compute the difference in height (subtract one from another, sorehead) and set up the problem on the E-6D thusly:

On the computer face, set difference in pressure height — on the miles scale over distance in nautical miles — on the minutes scale between the two points.

Now, chase around the computer until you find a scale marked latitude. Find it? OK — read out from

"The weather officer had computed my drift for me quickly and accurately."

"You get there fustest with the mostest because pressure pattern flying saves you both time and valuable fuel."

the average latitude of your flight to find the crosswind on the miles scale.

That's it. That's all there is! You now have crosswind in knots. Slap it on your computer at 90 degrees to your true course, turn the compass rose 90°, put the tip of the wind arrow on your true airspeed by moving the slide upward, and read off the drift angle — the one, single drift angle for the entire flight at altitude.

For the hotter stove pipe drivers who are completely buffaloed by the wind face side of a computer, we have an even simpler method to arrive at this single drift angle. Just place your TAS in knots (minutes scale) opposite your crosswind velocity in knots (miles scale). The black rate arrow points to your single drift angle. If you don't believe it, then try it.

Don't run away until I give you a few ifs, ands and buts.

★ It is accurate only for that portion of your flight at cruising altitudes.

★ You have computed a net motion of the air mass perpendicular to your flight path — that means you have crosswind only and crosswind can never be used to get ground speed.

How about running through that sample flight? We flew from Moody AFB to Chicago by way of Maxwell. Flight altitude 38,000 feet and TAS roughly 420 statute. We were at 38,000 feet prior to reaching Maxwell, so we will compute our single drift from Maxwell to Chicago. The first thing we do is ask the weather people for the heights of the pressure level over Maxwell and Chicago at the approximate arrival times. The forecaster gives us 39,420 and 37,360 feet MSL, respectively. To find the difference in height, we subtract algebraically departure from destination (Maxwell height from Chicago height), which gives us 2060 feet. This being a negative value means drift correction will be left. If it were a positive value, drift correction would be right.

Our basic flight planning consists of obtaining Flight Charts #187 and #229 and drawing a straight line on them from Moody to Maxwell, then another straight line from Maxwell to O'Hare. To get data for our flight between Maxwell and O'Hare (1) we measure the distance, 580 N. miles. (2) We carefully measure the true course at the midpoint, 353°, (3) we find the average magnetic variation, 3°E, and (4) finally we note the average latitude to be 37°.

Now what have we: TAS 420 MPH or 365 Knots (D^2D^1) Difference in height — 2060 feet, Difference in N. miles 580, Average Latitude 37°N. Drift Correction — Left, Average Variation — 3°E., True Course — 353°.

Now for the Computer: Place 2060 on the miles scale opposite 580 on the minutes scale. Opposite 37° on the latitude scale, we then read 126 on the miles scale. (See Fig. No. 1) This is the crosswind component: 126 Knots. All you have to do now is convert this crosswind to drift. Place the crosswind on the vector face from a direction of 90 degrees to the true course of 353 degrees (263°). (Fig. 2) Now rotate the compass rose 90° to the left (Back to 353°) and move the slide upward until the tip of the wind arrow is on your TAS of 365 Knots. Now you read your single drift angle at the tip of the wind vector to be 20 degrees (Fig. 3).

Another method to obtain this drift angle is to place your crosswind component of 126 knots on the miles scale opposite to your TAS, 365 Knots, on the minute scale and the black rate arrow points to your drift of 20 degrees.

$TC \pm W = TH \pm V = MH$

$353° - 20° = 333° - 3° = 330°$

That's the story. Over Maxwell, turn on course to Chicago, crank in —20 degrees drift correction and hold it until you split the cone at Chicago. You'll save time and fuel because what you are actually doing is flying a pressure pattern.

If you use single drift corrections to obtain single magnetic heading flights, there are three precautions to be observed: (1) if the difference in the magnetic variation at the beginning and end of your course is more than six degrees, the flight should be broken down into several magnetic headings to prevent you from getting too far from the pressure pattern flight path you have calculated (this is especially true on East-West flights), (2) you should get the weather forecaster to give you an accurate forecast on your effective headwinds or tailwinds so you can estimate your groundspeed (check this during flight) and (3) your Slave gyro MUST be accurate. ●

EJECTION PROCEDURES

F-94-C

F-86-D

LOCKHEED

F-80* B-C

1. Jettison canopy by raising jettison handle located in lower right side panel (with manual canopy, crack open 2" before jettisoning.)
2. Raise both armrests into latched position. (Left locks harness.)
3. Squeeze trigger on right armrest to jettison seat.

*There is no provision for seat ejection on F-80A aircraft.

F-94 A-B

1. Radar Operator raises radar console and lowers visor.
2. Blow canopy by pulling jettison handle located on right fuselage sill. (*Caution:* Do not raise right armrest on either seat before pulling canopy jettison handle, as this will make it impossible for the operator to move the jettison handle through its entire travel and prevent normal jettisoning. Furthermore, it is quite probable the canopy will not blow if unlocked prior to pulling jettison handle.)
3. R. O. must make an effort against strong airflow to assume recommended position for ejection.
4. Raise both armrests . . . right cocks trigger; left locks harness.
5. Squeeze trigger on right armrest. *Caution:* Don't hit seat trigger before or during canopy jettisoning as seat safety pin will bind and may not be extracted by canopy.

F-94C

In early models, ejection method is the same as in F-94A and B; however, in series AF 51-5567 and subsequent aircraft procedure varies:

1. After raising radar console, jettisoning canopy, etc., bring elbows in close to body and pull both hand grips to locked position. This will automatically raise armrests, cock trigger, lower seat and lock harness.
2. Before squeezing the trigger, be extremely careful to place both arms inside the armrests to assure clearance of cockpit sill during ejection.

Note: On series AF 51-5627 and subsequent aircraft, ejection through canopy is possible by simply locking right armrest and squeezing trigger.

T-33A

1. Blow canopy by pulling jettison handle located on right fuselage sill. (*Caution:* Do not raise right armrest on either seat before pulling canopy jettison handle for this will make it impossible for the operator to move the jettison handle through its entire travel and the canopy will not blow. Furthermore, canopy may not jettison if unlocked prior to pulling jettison handle.)
2. Raise both armrests . . . right cocks trigger; left locks harness.
3. Squeeze trigger on right armrest. *Caution:* Don't hit seat trigger before or during canopy jettisoning as seat safety pin will bind and may not be extracted by canopy.

Note: On T-33A series AF-51-9035 and subsequent aircraft, ejection through canopy is possible by the following method:

1. If canopy fails to jettison, raise right hand grip—
2. Raise left hand grip to lock shoulder harness—
3. Squeeze trigger.

REPUBLIC

F-84 B-C-D

1. Actuate canopy jettison toggle switch located on instrument panel. On F-84B and C only, crack canopy open about 2" before jettisoning. Canopy on D series should be fully closed.

Although ejection procedures are essentially the same for all jet aircraft, ignorance of the variations in the systems of different models of an aircraft could spell disaster.

F-84-F

F-89-D

	2. Raise left hand grip to lock harness. 3. Squeeze trigger.
F-84 E-F-G	1. Pull up right hand grip to jettison canopy. 2. Pull left hand grip to lock inertia reel. 3. Squeeze trigger using the canopy jettison handle as a support. *Caution:* Canopy charges will fire upon actuation of jettison toggle or right hand grip regardless of the canopy or battery switch position. Canopy jettisoning in F-84D, E, F and G series may not be effectual, however, unless canopy is fully closed.
F-86 A-E-F	**NORTH AMERICAN** 1. Raise right hand grip to jettison canopy. 2. Raise left hand grip to lock shoulder harness. 3. Squeeze trigger. *Note:* On F-86E-15, series AF-51-13046 through 51-13096, F-86F-20 series AF 51-13130 through 51-13169, F-86F-25 and subsequent aircraft, ejection through canopy is possible by the following method: 1. Raise right hand grip. 2. If canopy fails to jettison, raise left hand grip. This will lock shoulder harness and prepare seat to fire through the canopy. 3. Squeeze right trigger. *Caution:* Left hand grip cannot be actuated until right grip has been raised to full up position.
F-86D	Ejection procedures are the same as on F-86F, with the following exceptions: 1. There is no provision for ejection through canopy. 2. On F-86D-40 and subsequent aircraft, raise either armrest to jettison canopy and squeeze either trigger to eject.
F-89 A-B-C-D	**NORTHROP** 1. Raise left armrest. Canopy jettisons, radar scope dumps into stowed position, shoulder harness locks and hand grip separates from trigger. 2. Rotate right hand grip up to its locked position. Pilot's seat is lowered into ejection position. *Caution:* Keep feet forward as seat lowers. Don't accidentally hit the ejection trigger. 3. Place feet as far back as possible and squeeze trigger.

10 Rules for Ejection

★ Stow all loose equipment.
★ If at altitude, pull bailout bottle handle.
★ Disconnect all ties with the aircraft.
★ Disconnect oxygen hose clamp from harness to eliminate difficulty in leaving seat after ejection.
★ Lower P-3 helmet visor, fasten chin strap.
★ Keep head AS LOW AS POSSIBLE when jettisoning canopy.
★ After canopy has blown, sit erect, buttocks well back, chin in, head firm against headrest, feet tight in stirrups, arms locked in close . . . brace hard against the seat.
★ After ejection, release safety belt and shoulder harness and kick away from the seat.
★ Delay opening parachute if altitude permits. *Caution:* Don't pull ripcord until well away from seat.
★ If aircraft is in normal attitude and low altitude (2000') ejection is necessary, release seat belt and harness prior to ejection. Then kick away from seat fast.

Note: Ejection through the canopy is recommended only as a last possible means of escape in the event that the canopy will not jettison and a fatal crash is imminent.

Engine Icing...

To cope successfully with jet engine icing, a pilot should learn its causes, understand its symptoms and effects, and plan his flight accordingly.

We believe this article should be on each jet pilot's preferred reading list. It is a combination of several articles that have appeared in Flying Safety Magazine, revised and brought up to date by the Engineering Branch, Directorate of Flight Safety Research.

★ ★ ★

THE greatest icing problem confronting the jet pilot is induction icing. But if he knows when to expect it, what to expect, and what to do about it, then there's no real problem—*for knowledge is the way to confidence.*

The problem of air inlet icing in turbo jet engines was recognized by the military services and the engine industry in the early stages of the jet engine development program. A considerable amount of laboratory testing had been accomplished as early as 1944, and icing flight tests were begun on a J-31 centrifugal compressor type engine mounted in the bomb bay of a B-24.

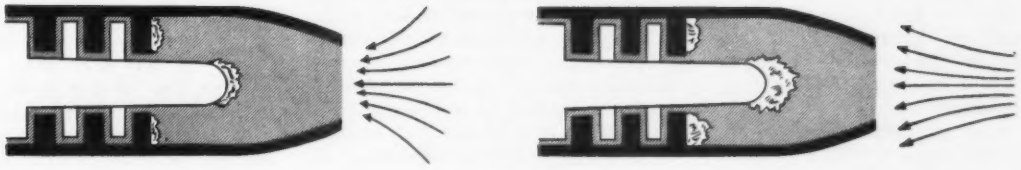
Such testing has been of a continuous nature ever since and the lessons learned should be of tremendous value to the jet pilot today.

As in all problems regarding ice on aircraft, i.e., ice on the wings, etc., certain atmospheric conditions must prevail at the time. The principal meteorological factors that contribute to jet engine icing are liquid-water content, air temperature and droplet size.

A definite amount of moisture content must be present in the air and the air temperature must be within a given temperature range.

Icing conditions are most prevalent when the outside air temperature is between a minus 10 degrees C. and a plus 5 degrees C., and the liquid water content ranges between 0.1 and

Airspeed vs. Icing



Diagrams show effect of airspeed on icing. In general, when the velocity of the aircraft exactly equals the velocity of air into the duct, the stream lines are straight in and the moisture taken into the duct is exactly equal to the moisture in the atmosphere. When the airspeed is lower than the velocity of air into the duct, the engine is then sucking air. Air is accelerated into the air inlet and there is a tendency for droplets of air to be centrifuged out of the air exterior of the duct. The result is a lower water concentration than in the ambient atmosphere. When the velocity of the aircraft is faster than that of the air going into the duct, the result is spillage or slipstreams around the end of the duct. This has a tendency to centrifuge the moisture into the duct, resulting in a higher concentration of moisture than in the surrounding atmosphere.

1.0 grams per cubic meter. Under these temperature conditions, all ice-producing moisture conditions are not discernible to the pilot or crewmember.

Generally, when the moisture content in the air is relatively high, and the temperature is within the described limits, ice is deposited in appreciable quantity on any object passing through it. A high moisture content is required to deposit ice on the wings which will be visible to the pilot.

A moisture content too low for wing ice formation may still cause ice to form in the jet engine air inlet system, however. Atmospheric pressure conditions directly affect ice formation; so a review of meteorological instruction courses should be made for a complete basic understanding of ice-formation theories. It must be remembered that the outside air temperature is not the criterion for icing temperatures in the induction system. The limiting factor is the temperature within the induction system itself, and this temperature is dependent upon air pressure differential which results from the venturi effect of the system.

In the jet engine, the air is drawn into the induction system by the compressor, or rammed into it by the high speed of the aircraft in flight. Under either condition, the air in the induction system is cooled by the drop in atmospheric pressure taking place due to acceleration of the air by the compressor. Without an adequate temperature indicator in the induction system it is possible to produce ice in that system and not know it, when the outside air temperatures are slightly higher than the freezing point.

Potential ice development is most prevalent in the axial flow type jet engine. The centrifugal flow engine can develop ice on its screens but the probability of developing ice is very minute and is not considered a problem by the U. S. Air Force.

Rate of Accretion

The rate of ice accretion in the jet engine induction system is dependent upon the amount of moisture in the air and quantity of air passing into the intake system. This, in turn, is dependent upon the turbine speed and the flight speed of the aircraft.

Unlike a reciprocating engine, the jet engine consumes large quantities of air in excess of that needed for combustion. This excess of air is needed to cool the hot sections of the engines. As ice forms, the total pressure at the compressor outlet is reduced. This loss in pressure results in decreased mass flow and consequently thrust, and is accompanied by an increase in turbine temperature. If the amount of fuel metered to the engine is not reduced, the temperatures in the hot section of the engine will rise until destruction of the engine may result.

It has been established by tests that ice formation in the induction system parts other than on the screens and inlet guide vanes has little effect on engine performance. However, the formation of ice on other component parts in the air-inlet area may, upon breaking off, damage the compressor section when passing into it.

Throughout the fall and winter seasons the atmospheric phenomena producing ice are going to be more prevalent than in warmer months because temperature conditions are more conducive to ice formation. However, it must be borne in mind that icing is possible in the summer months, as witnessed by the fact that eight F-84s crashed due to engine icing in July 1951.

Cold weather increases engine output performance, and as a result, loss of power from initial formation of ice may not be immediately discerned on a takeoff. When exhaust gas temperatures are normal, about 680°C, engine rpm 100%, ambient air temperature 0°C., the power output is 10% above standard maximum power. Consequently, a loss of power from the formation of at least 10% or more would have to be effected before it would ordinarily be detected.

As a precaution, engine rpm and exhaust gas temperature curves in the engine operating manuals should be consulted frequently for normal

power output during winter months operations.

All jet pilots and jet maintenance personnel should be completely familiar with Technical Order 01-1-469. Although very brief, this T. O. gives a thorough rundown on jet engine icing problems and how they may be combatted.

As noted previously, one of the most important factors in cold weather flying is for the jet pilot to recognize icing conditions.

At the risk of appearing repetitious we feel it necessary to reiterate one of the better known phenomena that accompany jet inlet icing. Inlet duct icing can occur without the formation of ice on the external aircraft surfaces. Pilots should paste that bit of information somewhere in their mental "immediate action" file.

Remember, when a jet aircraft is flying at airspeeds below 250 knots and at high power settings, such as in a climb, the intake air experiences a pressure drop when passing through the inlet screens. The pressure drop causes a decrease of air temperature. Even if the outside air is at an ambient temperature above freezing, it may be reduced to sub-freezing temperature as it enters the engine. Net result: Ice!

Wing icing may be expected when the temperature is between -10°C. and 5°C. and the dewpoint is within 4°C. of the temperature. In this range lies the danger, as wing icing is most unlikely for visible warning. Note that we have stressed the dewpoint here. Remember the old tried and true rule of forecasting fog? If the spread between temperature and dewpoint is 4° or less, formation of visible moisture in the form of fog is most likely.

Test Methods

From tests, it was found that ice in the induction system of jet engines could be eliminated by various means. Among the methods tested were surface heating by hot compressor air, continuous electrical heating and controlled alcohol flow. Surface heating proved successful when applied to inlet guide vanes and island fairings, but heating of inlet screens has not yet proved to be practical. Research on inlet screen anti-icing is continuing.

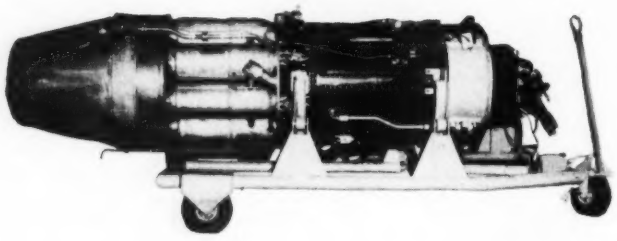
Northrop reported some success with use of an ice indicator and controlled alcohol flow on F-89 type aircraft, but this system was subsequently dropped. Weight factors, adaptability, cost and other criteria were considered in determining which method was most feasible.

General Electric has adopted the method of using compressor bleed-air forced through hollow inlet guide vanes with variations of continuous heat application, and automatic heat when needed, in addition to retractable air inlet screens. Newer Allison engines also incorporate a retractable air inlet screen with the use of automatic heat applications from compressor bleed-air.

The use of compressor bleed-air is a natural application for the axial flow engine. Compressor air is heated to over 450°F. from an ambient air temperature of 60°F. under normal operation. This is more than ample to eliminate icing. The bleed-air is used to heat and give complete anti-icing protection to the inlet guide vanes, island fairings and strut jackets.

The removal of screens in axial flow engines is an approved procedure for eliminating icing hazards in winter operations for those aircraft not equipped with inlet anti-icing. Screen removal (Ref: T.O. 01-1-469) is left up to the local commanders' discretion, since the added hazard of compressor damage from runway foreign particles has to be weighed against the possibility of icing.

For aircraft equipped with anti-icing systems, protection consists of (1) retractable compressor inlet screens, and (2) hot air already bled from the compressor. The compres-



ANTI-ICING FOR JET ENGINES

The following table outlines the status of anti-icing provisions in jet engines.

ENGINE	AIRCRAFT	PROVISIONS
J47-GE-7	F-86A	Not anti-iced, screens may be removed.
J44-GE-13	F-86A, F-86E, B-45	Not anti-iced in F-86s, screens may be removed. B-45s, some are anti-iced but have fixed screens. Screens may be removed.
J-47GE-9 and 15	B-45	Same as the J-47-GE-13 engine.
J47-GE-11	B-47	Not anti-iced, screens may be removed.
J-47-GE-19	B-36E, D	Plans to anti-ice by retrofit, screens may be removed.
J47-GE-17	F-86D	Anti-iced, retractable screens.
J47-GE-23, 25	B-47	Anti-iced with retractable screens.
J47-GE-27	F-86F	Anti-iced with retractable screens.
J35-A-5 through -33	F-84, B-45 and early F-89s	Not anti-iced, screens may be removed. J35-A-21s will be anti-iced by modification.
J35-A-35 through -41	F-89 late series	Anti-iced with some series having retractable screens.
J33 and J48	F-80, T-33, F-94	No provision for anti-icing considered necessary.

Design specifications call for anti-icing on all new model engines being developed for service.

sor air is used for partially counteracting the thrust load on the #2 bearing and is passed through hollow inlet guide vanes and special manifolding on the front of the forward frame struts. Thus the guide vanes and struts are adequately protected with no loss in performance. This protection is continuous whether or not icing conditions are encountered.

Additional compressor air is bled and led through special manifolds on the island fairings. Provisions are made for using this same air to heat the accessory cover (bullet nose). Island fairings and the accessory cover are heated only when icing conditions are encountered since the additional air extraction does result in some small loss in thrust (1—2%). This system may be turned on and off by means of a solenoid operated valve which will fail safe in the "open" (on) position, in the event of electrical failure.

Learn the Facts

The facts of jet engine ice formation should be learned and respected; however, there is no reason to fear engine icing provided operating personnel understand its symptoms and effects and plan accordingly. Meteorological information should always be studied for flight planning and ground runup to determine where conditions may be expected which are conducive to engine icing.

When icing conditions are encountered, ice should not be allowed to build up in the induction system of those aircraft equipped with manually operated anti-icing devices. When the anti-icing device is turned on after the ice has built up, there is a possibility that large pieces will break loose and damage the compressor rotor and stator blades or cause a flameout.

Screens should be retracted before ice forms and prevents retraction. Particular caution should be used during landing approach, where ice formation may result in loss of power and excessive tailpipe temperatures in case of a go-around.

For those aircraft not equipped with engine anti-icing devices, the following procedures should be considered:

1. Immediately upon recognizing the indications of engine icing — increased tailpipe temperature and loss of thrust — while flying in clouds or air with high relative humidity and low temperature (plus 15° C. to plus 0° C.), the pilot should retard the throttle, reduce airspeed and get out of the icing area.

2. Fuel flow variations should not be used to detect jet engine icing since contradictory signals are sent to the main fuel control during ice accretion.

3. If the icing area is a cloud entered from below, descend immediately while reducing throttle. If the cloud was entered horizontally, make a 180° turn while retarding the throttle and reducing airspeed. If the cloud layer is thin stratus, attempt to climb and get above the cloud while reducing throttle and airspeed. Leaving the icing area is the only method possible for eliminating inlet screen and guide vane icing in aircraft equipped with non-retractable inlet screens.

When engine icing has progressed far enough to cause an excessive tailpipe temperature and loss of thrust followed by an explosion and flameout, an attempt to air restart could result in more explosions or fire.

To illustrate the symptoms of jet engine icing, one F-84 pilot who encountered engine inlet screen icing in flight is quoted:

"I was climbing in formation somewhere between 11 and 13,000 feet. At the time, I checked my airspeed at about 215 mph. I was also looking at the tailpipe temperature and noticed it going up slowly and steadily, so I cut back power to about 80 per cent, shoved the nose down and regained airspeed of 300 trying to stay on heading. I climbed out of the cloud at about 15,000 feet after I regained my airspeed and then increased the throttle setting to 90 per cent. My tailpipe temperature had gone up too high. It went up to between 775 and 800 degrees before I cut back the power. I encountered no further trouble and returned to base."

Another F-84 pilot in the same flight gave this account:

"After we entered the cloud I lost contact with my flight leader in front of me. Immediately after that I had a flameout. My fire warning and overheat lights came on and my tailpipe temperature went up and hit the peg. I also had at the same time — I don't know whether you would classify it as an explosion — but it was the same type of sound you have when you change from your normal fuel system to your emergency. I slowed my airplane down to approximately 240 mph. When my rpm reached approximately 18 per cent, I switched to alternate and tried an airstart. As soon as I opened my throttle up, I had a fire warning light go on and overheat light with 1000 degree tailpipe temperature."

This pilot was forced to eject.

Whether you are flying an aircraft with or without anti-icing equipment, know what to do when you meet icing conditions. Don't be caught unexpectedly. Plan your flight to avoid the ice, when possible, or if you have anti-icing equipment, "anti-up" before you enter the icing area. ●

Jets and their pilots are built to withstand stresses but there is a limit to everything. Men and machines are no exceptions

By Captain Edmund F. Hogan, ANGUS

IN the good old days of aviation the red line on the airspeed—if there was one—was fixed solely by structural limitations.

The speed of modern jets, however, is limited both by structural limitations and compressibility effects. The approach of compressibility is easily measured by the Mach number which, briefly, represents the ratio between the speed of the aircraft and the speed of sound. As the airplane reaches toward the speed of sound, the airflow at some point on the aircraft's surface arrives at the point first. This is not as complicated as it seems at first glance. What happens is this:

The aircraft's wing forces the air to flow around it in something other than a straight line. This deflected air travels farther than the straight line distance between leading edge and trailing edge of the wing. Consequently, it moves faster flowing around the wing than the straight line between two points. Thus, when the aircraft gets quite close to the speed of sound, the speed of the air flowing around the airfoil has already reached sonic velocity. In modern jet fighters this usually occurs at Mach .8 or .9 for the aircraft. This means that when the machine is flying at eight-tenths or nine-tenths of the speed of sound, the air is flowing over some part of the plane's surface at Mach 1. It is then the effects of compressibility becomes noticeable.

Wartime conventional fighters tended to pitch down when they reached compressibility. Modern jets usually pitch up as they arrive at transonic speeds with the exception of the very high speed, thin wing type. At altitudes above 25,000 feet, the pitch-up is less severe than that which occurs upon reaching transonic speeds or compressibility at a point below 15,000 feet. Further, the pitch-up at altitude is overcome more easily, normally with forward stick pressure.

In the final analysis, compressibility occurs or does not occur pretty much as the jet pilot wills. For this reason flight technique is of utmost importance. Two instruments are invaluable aids to the pilot—his airspeed indicator and Mach meter. A third instrument, the accelerometer, is concerned with G forces which will be discussed subsequently.

The speed of sound is not constant. It varies with temperature and density altitude. It reaches its maximum at sea level and decreases with altitude. On a standard day at sea level the speed of sound is 761 mph. At 35,000 feet it is approximately 670 mph. As a rule of thumb, jet aircraft will hit the transonic zone at an indicated airspeed of 670 mph at sea level; 545 mph at 10,000 feet, 460 mph at 20,000 feet and 290 mph at 40,000 feet. The airspeed indicator is equipped with an extra needle, painted red. It is calibrated to indicate constantly—regardless of altitude—the point at which the aircraft will begin to enter compressibility.

More accurate than the airspeed indicator is the Mach meter. This is red-lined at the critical speed, or Mach number, for the particular type of aircraft. It relates airspeed in terms of Mach value and serves as an excellent cross-check on speed.

The accelerometer tells the story of G forces. These are the second limiting factors being imposed upon the aircraft. The instrument is red-lined at the various critical G forces, and common sense should dictate caution. Exceeding the G limitations can only lead to trouble.

The force of gravity equal to the weight of the aircraft is expressed as G. This is a one-G force. At four G's the force of gravity is four times the weight of the aircraft. Jet aircraft are built to withstand great stress loads. Generally speaking, except for shock loads jet aircraft can handle a limit load of 7.33 positive G's in their clean configuration. But design specifications provide a safety factor of 50 per cent, which means that the load could go as high as 11 (positive) G's. Naturally we do not recommend piling on the G forces needlessly—but that safety factor can be comforting when really in a bind.

The manner and direction in which forces are applied in relation to the aircraft and the body are of prime importance. When the force is directed from the head to the feet, the G is said to be positive. When the force is directed from feet to head, the G becomes negative.

If an aircraft is designed for a limit load of 7.33 positive G's, it should permit this number to be pulled as often as desired without damaging the aircraft. Wrinkles and popped rivets result when the limit load factor is exceeded. Beyond 11 positive G's structural failure may usually be expected. In this respect, accelerometers do not give true readings for shock-type loads such as are encountered in hard landings.

Still, the jet pilot who looks forward to the luxury of puttering around a house financed from retirement annuity funds, might inspect closely this area of G forces. For instance, it is possible to pull positive G's safely, starting at the red-line airspeed, provided the aircraft is in a very shallow dive. In such a maneuver the aircraft slows up as the G's are applied. By the time the load has built up to 7.33 positive G's, the aircraft has lost from 35 to 50 mph because the aircraft automatically loses speed with the application of the G's and it does this rapidly enough to avoid effects of compressibility.

On the other hand, if the aircraft is in a steep dive and has been picking up speed, it will not slow down as

YOU VS "G" AND

the G's are applied. In this instance the speed of the aircraft is increasing during the application of the G's and could easily exceed the limiting Mach number at the time that 7.00 or more positive G's were being applied.

Stability of the aircraft will change, usually at the time when it is approaching the ground rapidly. More often than not in such an instance the aircraft simply runs out of altitude before a pull-out can be effected.

Speed and G forces can be considered separately but in the actual practice of jet flight, they march hand in glove. So present-day designs require that the pilot be familiar with the VG diagram. The "V" stands for speed or velocity, and the "G" obviously for G load. The diagram is an essential part of the basic design of each aircraft. As soon as the designer determines the wing loading, power loading and intended performance, he plots the VG diagram. This diagram is included in the Tech Order for each type of jet aircraft. If thoroughly understood, it eliminates experiments of the trial and error kind, for it tells the jet pilot the limitations of his aircraft before he ever leaves the ground.

The VG diagram shows how stall and compressibility limit maneuverability at various altitudes. The curved line on the left of the diagram represents the stall boundary, indicating at what combination of G's and speed it is possible to stall the aircraft. One section covers the complete speed range of the airplane and extends from the negative to positive G load limit. This area constitutes the legitimate maneuvering range pilots can use.

The diagram will prove that modern jet fighters can fly at speeds sufficiently fast in level flight for structural failure to occur. It proves, too, that whenever a modern jet fighter operates at low altitudes, it is flying in a region where indicated airspeeds build up tremendous dynamic pressures on the aircraft. Considering the fact that the VG diagram contains so much valuable information, it is strange indeed that so few checkout questionnaires refer to it.

With the development of high-speed aircraft much attention has been directed toward the pilot's ability to withstand the G forces associated with acceleration. The sense of urgency has been greater in the last few years because designs for speed have progressed so far in such a relatively short time. But in fact the study has been continuing since World War I, when extensive experiments concerning the effect of centrifugal force on the brain were conducted.

Many jet aircraft have been damaged badly because a pilot pulled positive G's in excess of the designed strength. Damage has ranged from minor wrinkling of the wing skin to tearing off the wings and disintegration.

"G" Tolerance

An Air Force study of human factors in major accidents of jet aircraft notes that the average pilot has a tolerance to positive G forces of approximately 6 G's for 15 seconds, 7.5 G's for five seconds and 9 G's for three seconds (providing the 9 G's are reached in one second), without the use of the G Suit. But this was found to be true only if the individual was in good mental and physical condition and was actively resisting the effects of positive G forces by straining both leg and abdominal muscles. Straining these muscles helps the blood return to the heart.

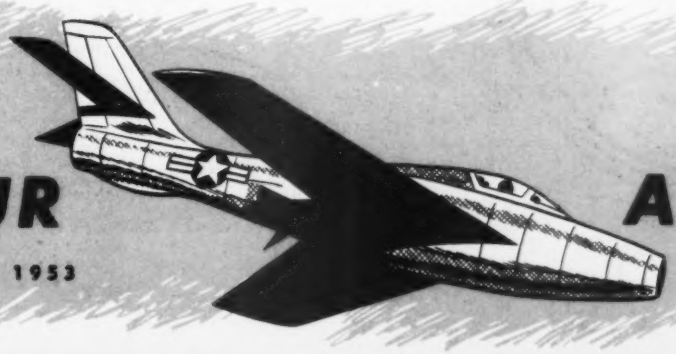
If the pilot relaxes his muscles virtually all of the blood will pool in the lower portion of the body, insufficient blood will return to the heart and the heart will be unable to maintain circulation in the head. And when circulation through the brain stops, unconsciousness follows in three to four seconds. Recovery from unconsciousness produced by high G forces is slow and is accompanied by convulsions followed by a state of mental confusion. The average pilot would not be able, the survey states, to control an aircraft for at least 20 seconds after losing consciousness under high G forces even if the G forces were lowered immediately.

A number of physiological and psychological stresses alter the tolerance to G's. Worry can cause a pilot to forget to tighten his leg and abdominal muscles. So can lack of sufficient oxygen, carbon monoxide in the blood stream, upset stomach, gas pains, and so forth. Additionally, there are definite stresses which directly lower tolerance to G forces by decreasing elasticity of blood vessels. If the blood vessels relax completely, the volume of the blood vessel system of the body increases so much that there is not one-half enough blood to fill it, and even one positive G cannot be tolerated. There can be various degrees of relaxation of the blood vessels which would produce various degrees of tolerance to G forces. An individual can and does vary from day to day, depending upon his state of health and well-being.

Nausea from any cause is accompanied by a relaxation of central blood vessels, a slowing of the heart's rate of beating, a lowering of blood pressure, and a very marked decrease in tolerance to a positive G force. A nauseated individual may not even be able to tolerate one G.

Always present in aerial maneuvers is the possibility of vertigo. Further, there is the possibility of upset stomach, excessive heat, hypoxia, high G forces and emotional disturbances. Physiologists and others concerned with a pilot's ability to withstand G forces encountered in high speed flight advise that a pilot should break off a mission and return to his base whenever he feels "bushed." Bravado, they observe, is a poor excuse for loss of life and expensive equipment.

The jet pilot, they note, would be well advised to keep in mind that he —and his machine—have limits beyond which it is not safe to experiment. ●



Flying a Flameout!

Scientific research and experiments with simulated flameout landings have resulted in revised techniques for deadstick landings in jet aircraft.

By Maj. Robert M. Stevens, Fighter Branch, D/FSR

EVER since the first pilot took off in his spit-and-paper kite, the problem of deadstick landings has been throbbing in the recesses of his mind. In the old days of the Nieuport, every landing was, for all general purposes, a deadstick . . . it had to be . . . the Gnome-LeRhone had no throttle, and to make a landing you just toggled the cut-out switch and blipped her on in to a walk-away landing.

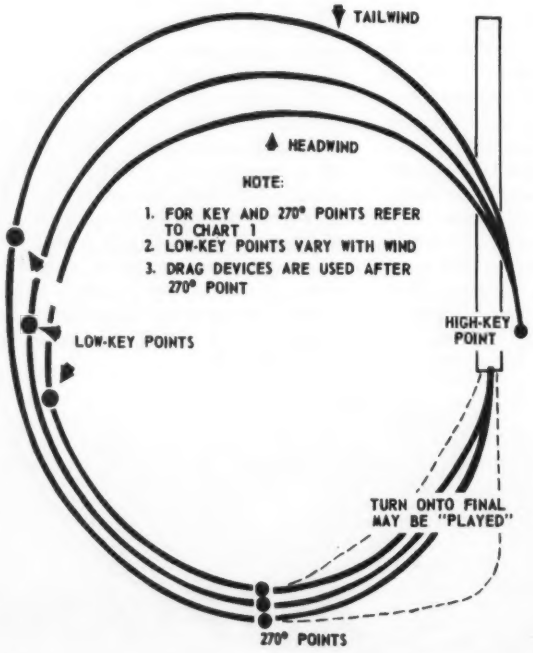
Came the era of the carburetor, and the intrepid aeronaut still kept glancing around for a landing area, just in case his mill quit. And now, with jet propelled airplanes, he still keeps his neck on a swivel and plans what he will do if he loses his fire. About the only *genus aviator* who doesn't worry about deadstick landings is the glider pilot, and he wouldn't know what to do with a throttle if he had one.

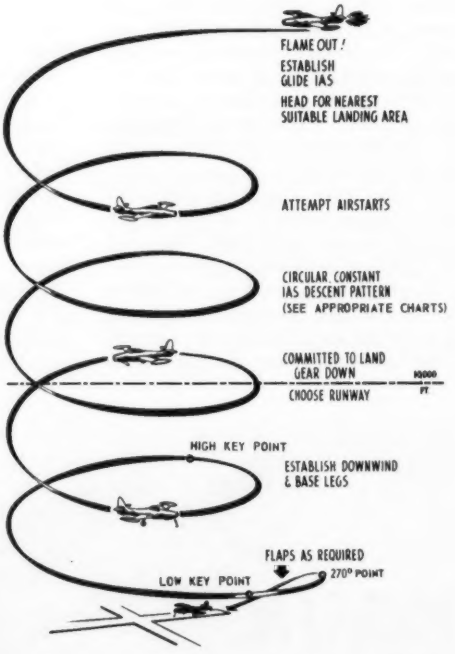
In order to further the science of putting down a jet job stone cold dead in de market, the Directorate of Flight Safety Research requested Air Research and Development Command to run a series of simulated flameout landings in various types of jet aircraft. The results of these tests were previously described in FLYING SAFETY.

A basis for the claim that this research has paid off in terms of aircraft dollars saved, is the letters received from all major USAF commands, outlining the number of successful (minor or no damage) forced landings accomplished in each command.

These figures, coupled with data researched by the Directorate's Records and Statistics Division, indicate that the U. S. Air Force-wide "practice" or simulated flameout landing program has been extremely successful.

Comparing two periods, the first from 1 November 1950 to 31 October 1951 (before practice), and the second from 1 November 1951 to 31 October 1952 (after practice), it was proved that the accident rate in this category decreased 29 per





cent in the second period. This point is further emphasized by the fact that although total jet flying hours increased 48 per cent in the second period, the dollar loss increased only 11 per cent, for an estimated saving of several million dollars. Because of 175 successful forced landings during both periods, the savings in airframe costs alone is estimated at nearly 20 million dollars.

The study of jet flameouts is not static. It is set up on a continuing basis by Air Research and Development Command, in order to obtain ultimate information on jet flameout landings under all conditions in present and future jet fighter types. In addition, the Directorate of Flight Safety Research continues to study and recommend new techniques, based on thorough analysis of jet fighter accidents, and this information will be disseminated to pilots through Pilots' Handbooks and other printed media.

Tests Conducted

Flight tests were conducted at Edwards Air Force Base in 1952 to determine the best possible procedures in flameout landings for F-84G, F-86E, F-86D and F-94C aircraft.

In the analysis of this information it was discovered that certain basic changes would improve the previously recommended landing pattern. The major change is the modernization of the circular (360-degree overhead) landing pattern and the readjustment of key point altitudes as shown on the accompanying charts.

In addition, the Edwards AFB test report states that it has now been proven that the hydraulic irreversible "normal" flight control system on F-86E and F-86D airplanes is fully operable with the power provided by a windmilling engine. Another significant finding of the later tests is that landing flaps on F-86E and F86D airplanes can be used on final approaches as a result of the new interconnected flap design.

Improvement of the pattern used in the early flameout landing study as prepared by the Directorate of Flight Safety Research was recommended by test pilots at Edwards AFB. This revision calls for three pattern points, with corresponding altitudes, rather than the two points used in the original tests.

The first or "High-Key" point remains in the same geographical pattern location and is established on the initial approach at a specified airspeed and altitude with gear down and locked. At this "High-Key" point a specific and constant rate-of-turn should be started and maintained until the 180-degree or downwind point is achieved. Here is the point where a positive decision must be made by the pilot, and depending on the prevailing wind, the pattern must be "played" from here on. As this 180-degree point is the location of resolution and is the spot where the pilot must make his first evaluation of his ability to properly hit the runway, it is now known as the "Low-Key" point. The last significant altitude is at the 270-degree (base leg) point. From here to touchdown, a successful landing is effected through the proper use of flaps, speed brakes, and if necessary, controlled side-slips and fishtails. (Consult the Dash-One T. O. for slip restrictions on your aircraft.)

The aiming points on the runway remain unchanged. For a headwind condition, shoot for the midpoint of the runway; if a tailwind prevails, shoot for the first third of the runway.

As in all flying techniques, there must be a flexibility of pattern to conform to the hundreds of varying conditions. The figures shown in the charts on this page are for optimum conditions only in the sense that the resulting pattern is easily flown and gives accurate results.

It is possible to perform the entire 360-degree pattern at altitudes different from the values shown, depending upon the judgment of the pilot. If you happen to come out at the High Key point at an altitude lower than that specified, it is possible to complete the approach by cutting the pattern smaller, with accompanying increased rates of turn. However, these steep, tight turns can become uncomfortable with boost off.

At this point, the difference between emergency and forced landings should be emphasized. The following descriptions of a "forced" and an "emergency" landing still hold good.

An emergency landing is a precautionary landing made at the pilot's election, and under conditions where he has control of power and flight controls.

A forced landing is a landing under conditions where loss of power control or partial loss of flight controls precludes further flight.

A word about canopies. It is important that all canopies be jettisoned in setting up the airplane for a forced landing. In emergency landings, sliding canopies should be opened and

Actual Flameout Data

Aircraft Type	F-84G	F-86E	F-86D	F-94C
High-Key Altitude—Ft.	5,500	6,000	6,500	10,000
Low-Key Altitude—Ft.	2,500	3,000	3,500	5,000
Base (270 deg pt) Leg Alt—Ft.	1,300	1,500	1,500	2,500
Best Glide IAS—K (Gr Down)	180	185	185	175
Rate of Desc—Ft/Min (Gr Down)	2,150	2,000	3,050	2,600
Rec Rate of Turn (Gr Down) Deg/Sec	3	3	3	1.5
*Rec Final IAS—Knots	130	150	150	160
*Rec IAS at Touchdown—K	120	130	135	120
Best Glide IAS—K (Gr Up)	190	185	185	185
Rate of Desc—Ft/Min (Gr Up)	1,600	1,850	2,100	1,900
**Rec Rate of Turn Deg/Sec (Gr Up)	3	3	3	1.5
***Rec Alt for Lowering Gr Nor Sys—Ft.	12,000	12,000	12,000	15,000
Approx. Pattern Radius—N. Mi.	1	1	1	2
Avg Windmill RPM Below Hi-Key-%	12.5	13	13.5	7
Avg Test Time fr Hi-Key to T. O.	2.2	1.7	1.8	3.3
Avg Time for Gr to Lock Dn—secs	25	15	27	19

* Assuming no wind and approximately 600 lbs. of fuel remaining.
** Completely elastic depending on position and altitude.
*** Only if the field is definitely within gliding distance. Rates of descent were taken at 15,000 ft. with gear up and 5,000 ft. with the gear down.

Flameout Simulation Data
(Boost Off, Except for the F-94C; Speed Brakes Out)

AIRCRAFT TYPE	F-84G	F-86E	F-86D	F-94C
Best Glide IAS—Knots (Gr Up)	190	185	185	185
Avg Rate of Desc 25-12,000 ft (Gr Up)	1,650	1,850	2,200	1,900
Avg Power-RPM-%, 25-12,000 ft	65	72	79	79
Best Glide IAS—Knots (Gr Dn)	180	185	185	180
Avg Power-RPM-%, 15,000′ -SL (Gr Dn)	58	69	74	69
Rec Alt for Lowering Gr (Ft Abv Grnd)	12,000	12,000	12,000	15,000
Rec Rate of Turn—Deg/Sec	3	3	3	1.5
*Best Final IAS—Knots	150	150	150	160
*Rec Touchdown IAS—Knots	120	130	135	120
Fuel Consumed, 25,000 ft-SL lbs.	100	235	165	205

*Assuming no wind and approximately 600 lbs. of fuel remaining.

Pattern Altitude Variations

A/C Type	High Key Alt --- Ft.	Low Key Alt --- Ft.	270 Deg Point Alt --- Ft.	Corresponding Rates of Turn Deg/Sec
F-84G	3500 - 7500	1700 - 3700	900 - 1700	4 - 2
F-86E	4000 - 8000	2000 - 4000	1000 - 2000	4.5 - 2
F-86D	4500 - 8500	2200 - 4200	1000 - 2000	4.0 - 2
*F-94C	8500 - 11500	4200 - 5800	2000 - 3000	2 - 1.5

*The F-94C pattern is designed around the handling qualities of the airplane without boost to be entirely safe in the event of boost failure in the pattern.

the jettisoning of clamshell canopies left to the pilot's discretion.

The recorded experiences of over 600 jet fighter pilots who have had to evacuate crashed aircraft clearly indicate the desirability of pre-crash canopy removal. Of these pilots, 110 experienced difficulty in canopy removal following a crash landing. As a direct result of post-crash fires, six received fatal and seven received major burn injuries. Eight others trapped in cockpits of burning aircraft were saved only by the prompt action of crash crew personnel. An analysis of these accidents proves conclusively that the majority of crash-landing injuries were not caused by impact forces and prompted the recommendation to jettison the canopy prior to execution of a forced landing.

Here is another moot point which you F-86E, D and F jockeys had better paste in your helmet. Comes a turbine seizure (and you will know it when you get complete, *but complete*, loss of rpm), get ready to go over the side. Of course if you are over an established airfield at a fairly low altitude, and you are sure that you can make the field, then best ride it down. Remember though, in the F-86E, F and D models without engine windmilling, your alternate flight control is dependent on the battery, and the battery may last only a few minutes.

Another point along this line: With a seized turbine, your rate of sink increases about 35 per cent over normal gliding ratio.

We cannot stress the point too strongly that the information contained in the studies of flameout landings be used constantly in the education of jet pilots, regardless of their experience level. These facts should be impressed indelibly on the mind of every man who flies a jet, until his reactions in making a flameout landing become natural reflexes. The end result will be a further improvement in flameout landing accident rates. ●

A study of 97 jet fighter forced landing accidents shows that your walkaway chances in this unpopular type of landing are good. This is attributed mostly to the higher stressed cockpits—high G-force seats and the wearing of the shoulder harness. To use statistics: 98 per cent of the aircraft involved were substantially or totally wrecked; yet, 75 per cent of the pilots were not injured. When one considers that 95 per cent of these jet forced landings were accomplished without a fatality, the picture becomes even brighter.

There is still no substitute for the calm analysis and keen judgment required to handle an emergency: these are personal attributes of the individual pilot.

Airstarts call for more practice. In more than 28 per cent of the forced landings due to flameouts, airstarts were unsuccessfully attempted. While the reason for the failure of these engines to start was not always known, the Forms 14 often showed that airstart procedures were either too hastily or incorrectly performed. This phase of training is one that cannot be "over-learned."

Fuel exhaustion, a factor most vital for jet pilots in their preflight planning, showed up in the survey with alarming regularity — approximately 25 per cent of total causes of forced landings. Here again is reflected inadequate training in flight planning, or an utter disregard for the range limitations of jet aircraft. Here too, as a contributing factor, is poor flight leadership. In four accidents, wingmen became separated from their flight leaders, subsequently became lost, exhausted their fuel while stooging around looking for a field, and finally had to crash-land.

Primary Cause Factor

The primary cause factor leading up to the emergencies was powerplant failure with 51 cases, or 53 per

OFF - THE - BASE *Forced Landing* TECHNIQUE

cent. ARDC and AMC have a continuing project to improve the reliability of jet engines. New manufacturing techniques have resulted in a general decrease in jet engine failure rates during the past two years.

Another obstacle that hindered these pilots was loss of flight control boost, because of insufficient hydraulic pressure. This condition led to at least one fatality and was a suspected factor in three others. Several other pilots were so occupied in maintaining aileron control that they failed to plan their approach properly and wrecked aircraft resulted. The answer to this problem is that it is essential that any program of practice forced landings be done with flight control boost off, in order to familiarize pilots with the possible loss of this system under emergency conditions.

Flaps and speed brakes were used in about 60 per cent of the landings. However, full dependence on these controls will not prevent overshooting or undershooting of the intended landing area, for many of the overshooting planes had flaps down. These accidents occured before the practice jet fighter forced landing program was accepted training. The pilots were not familiar with simulated dead engine flight characteristics and generally made high, fast approaches. Then, too, perhaps they had never been briefed in the slipping or "fishtailing" characteristics of their aircraft and did not use this method to lose altitude and airspeed. (Consult your Dash One T. O. for slipping restrictions on your aircraft.)

Approaches Important

Approaches are most important in this business of staying in one piece. Rectangular patterns with straight-in approaches outnumbered the 360° overhead pattern in power off landings, three to one. In making the 360° "pitchout" tactical pattern, the pilot's judgment was affected more adversely than in the straight-in type. Of 21 pilots who used the tactical approach, more than 50 per cent overshot; 25 per cent undershot, and the remaining percentage hit their intended landing area.

The rectangular pattern was favorable to the pilot. Fifty per cent of the pilots in this category put the aircraft down in the intended landing area. These figures point to a large spiral type descent over the intended area (if altitude is to be lost) with a rectangular pattern plus a straight-in final, as being good solid emergency flying.

In report after report the killer was excess airspeed on final and touchdown. Without engine power, hydraulic pressure or electrical power a pilot sometimes does not have flaps or speed brakes; however, the stalling speed of the aircraft is the same as the power-off configuration as shown in the Dash One T. O.

It is the psychological effect of having to "groove it" that undoubtedly influences the thinking of the pilot. For fear of undershooting the pilot subconsciously compensates by building up excess airspeed. Speeds of 60 knots above normal approach speed were not uncommon. This condition has proved just as disastrous as the low airspeed antic.

Regarding this high-speed approach, pilots placed too much emphasis on the fuel-load speed ratio and in many instances came in far too fast. Actually, a good rule-of-thumb calls for adding five knots above normal approach speed for every 100 gallons of fuel over normal landing load. On this basis, 15 knots would be the maximum airspeed increase required for a full internal load. It is assumed that the external tanks will be salvoed in plenty of time to insure getting rid of both.

The following is a general SOP covering both the pre-landing emergency and the actual forced landings:

★ When the emergency occurs, head for the nearest field.

★ Set up proper glide according to A/C Tech Order. (Better know your Dash One, buddy.)

★ Airstarts should be attempted (if engine is not damaged) down to approximately 10,000 feet above terrain. It is this altitude where a decision to bail out or crash-land can be more accurately made.

★ If an airport landing is to be attempted on a known runway length, gear should be down and locked at sufficient altitude to enable the pilot to concentrate on pattern work. If the gear cannot be completely downlocked, either by normal or emergency methods prior to final approach, it is safer to retract the gear for a belly landing.

★ As for pattern, the one shown in the accompanying diagram is the best proven method of spiking it in the intended landing area like an old pro.

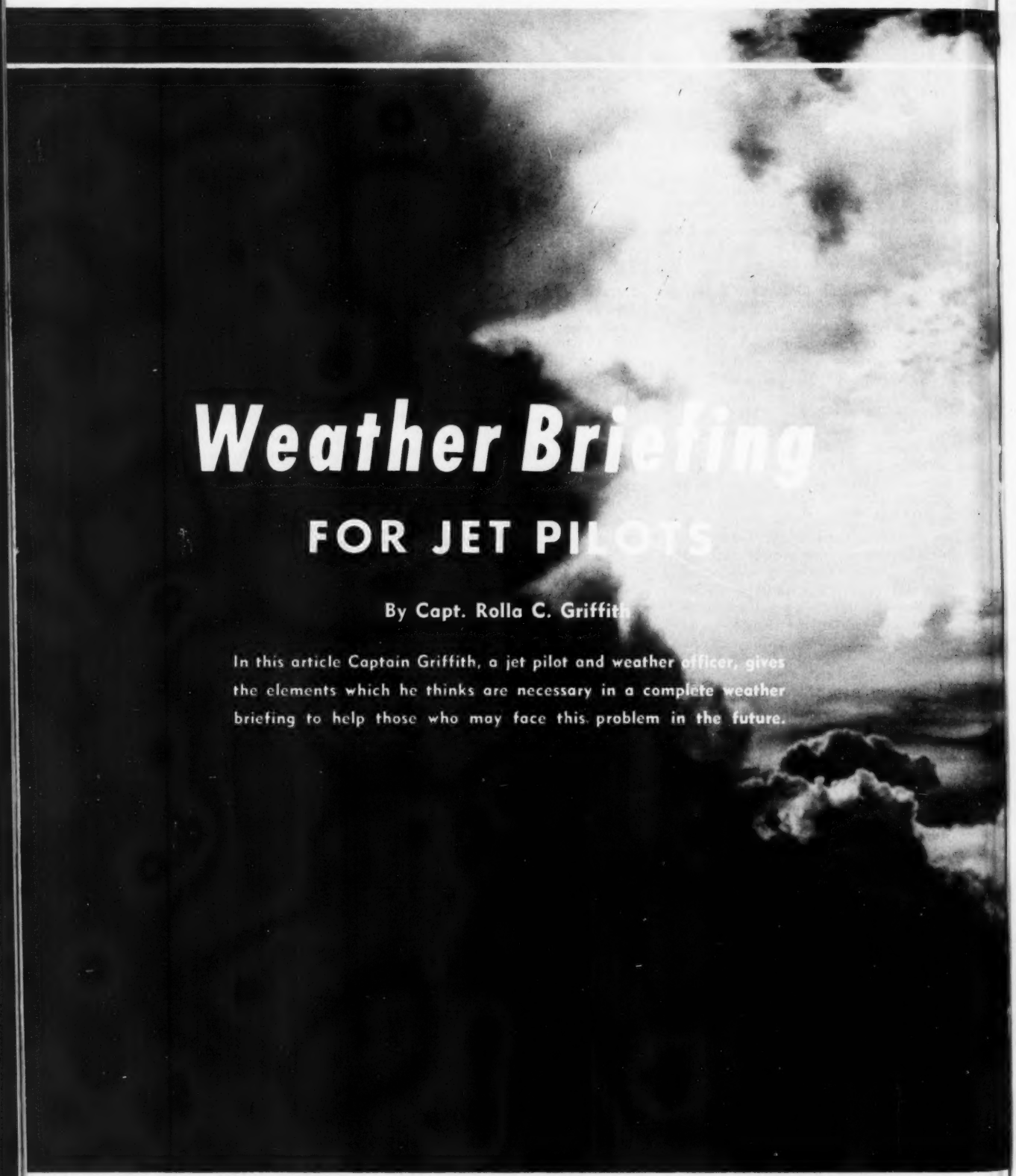
★ Flaps and speed brakes should be used, if available, to lower the aircraft's touchdown speed. In water landings, the flaps will rip off or "give" on impact and not cause a nose-in effect. *Landing gear should be up on all ditchings!*

★ Jettsion external loads before entering the pattern, if possible. Sliding distance will be lessened. Wing tanks, if empty, will afford additional buoyancy in ditching, however.

★ Canopy should be opened or jettisoned at pilot's discretion prior to final approach.

★ Make sure shoulder harness is tight and locked—also that helmet is on securely.

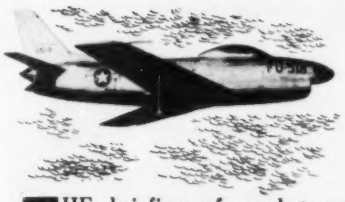
★ Cut the fuel and switches off when "you've got it made."



Weather Briefing
FOR JET PILOTS

By Capt. Rolla C. Griffith

In this article Captain Griffith, a jet pilot and weather officer, gives the elements which he thinks are necessary in a complete weather briefing to help those who may face this problem in the future.



THE briefing of combat crews flying jet fighters is a job comparatively new in the Air Weather Service. Although the elements included in such a briefing are generally the same as those given to conventional pilots, the speed at which jet aircraft operate and the vast difference in fuel consumption at various flight altitudes necessitate additional information in the briefing. The type of mission to be flown determines which elements may be eliminated, while the importance of others must be stressed.

Winds

The wind direction and velocity for the 10,000, 20,000, 30,000 and 40,000-foot levels must be given accurately. The amount and type of ordnance carried by the aircraft depend on the winds aloft and whether the winds will be beneficial or detrimental. It appears that a headwind on one leg of the flight would be compensated for by the resulting tailwind on the opposite leg but this is not true in jet operation. A headwind on the flight to the target requires a reduction in the ordnance load because the aircraft is unable to attain optimum altitude with an external load.

The first principle of jet operation is that as the flight level increases, the fuel consumption decreases, and fuel consumed on the trip to the target cannot be compensated for on the return flight regardless of the flight altitude.

The minimum fuel load with which the aircraft must break combat or leave the target area is computed prior to takeoff, and the wind forecast is of prime concern to the operations officer who makes the decision on the minimum fuel figure. To have a jet land with an extra 100 gallons of fuel aboard because of a poor wind forecast is a great waste. One hundred gallons of fuel means five minutes flying time at 1000 feet, but 35 minutes at 40,000 feet. The importance of accurate wind forecasts cannot be overemphasized.

Pressure Altitude

The optimum altitude is the most efficient altitude at which the aircraft can proceed to and return from the target. Optimum altitude is given as density altitude and the weather officer converts it to pressure altitude, which the pilot reads directly from the altimeter by taking into consideration the temperature correction. The indicated or pressure altitude varies with warm and cold air advection aloft.

In warm air, fuel is saved because the jet can fly at a lower indicated altitude and still be at optimum. For example: If 30,000 is the optimum and the temperature at 30,000 feet is —35°C., the pilot must climb to an indicated 31,000 feet to be at the optimum of 30,000 feet. This is a simple calculation on an E6B computer, available in any operations office.

Target Winds

For increased accuracy on dive bombing missions the surface wind must be taken into consideration. If an approximation is given at briefing, then the direction of the dive bombing run and release altitude are planned before takeoff. Briefing on the prevailing wind direction and velocity below 10,000 feet serves a secondary purpose.

Interrogation of pilots who have bailed out of their aircraft over enemy territory brought out one fact. Had they been aware of which direction they would drift after jumping, their bailout could have been planned more carefully. One pilot stayed with his plane until an instant before it exploded in order to get out over the Yellow Sea. Actually, he could have jumped much sooner and been carried over the water by the prevailing wind. This was particularly applicable in combat areas such as Korea where a landing in the water meant almost certain rescue.

Runway Temperatures

The ambient temperature is all-important in jet operation. Warm days lengthen the takeoff run, lower the ordnance load, and reduce the efficiency of the jet engine by lowering the amount of thrust available at maximum power settings. The reasons for this may be found in any manual explaining the principle of jet propulsion. For example: With a 6000-foot runway and a runway temperature of 40°F., an F-84 can carry an external load of over a ton. At 80°F., the load is reduced to 700 pounds, and with a 95°F. temperature the external load becomes zero.

Mechanical aids are used when temperatures are high, but an accurate temperature forecast is essential for planning purposes. Many elements affect the runway temperature. They are: amount of cloud cover, surface wind direction and velocity and the construction of the runway. Radiation differs slightly on pierced steel plank, concrete and asphalt.

Freezing Level

Glaze and rime icing are of minor importance to jet aircraft because their cruising altitude is high enough that all mosture is in ice crystal form.

The ascent and descent through the dangerous icing levels are made at speeds which allow the ice a minimum of time to form on the wings and control surfaces. The intake screen is the danger point. When glaze ice forms over this screen, no air reaches the impeller section and engine failure results. (See article on Jet Icing in this issue, page 16.)

Areas of super-cooled droplets, such as thunderstorms, are the most dangerous and must be emphasized. Windshield icing is picked up on all descents through clouds, but normally is of little importance. Frost forecasts to the maintenance section are necessary to insure placing protective coverings on the aircraft at night.

Target Temperature

Briefing on the temperature in the target area and of bodies of water flown over or near is very helpful information for the combat crews. An example of poorly informed pilots are those who dress for the temperatures at the home base regardless of the temperatures in the area where they might be forced down. The jet pilot is overburdened with equipment, and anything the forecaster can do to lighten the load is helpful. If they are informed, they may dress to suit the weather for all areas over which they fly.

Synoptic Situation

For briefing, the weatherman and pilot should go over a map which covers a large enough area to show the pressure system and frontal locations affecting the route of flight. Also, a pictorial cross section should be studied showing just exactly what the pilot may expect in connection with the synoptic situation. Weather information graphically displayed is more easily assimilated.

Altimeter Setting

Under instrument conditions an altitude is decided upon as the minimum to which the aircraft will descend in the overcast. There is no problem at an established base where

JET WEATHER HIGHLIGHTS

★ *Winds* ... The amount and type of ordnance carried by the aircraft depends upon winds aloft.

★ *Altitude* ... The optimum altitude is the most efficient altitude at which the aircraft can proceed to target and return.

★ *Target Winds* ... Surface winds must be taken into consideration on dive bombing missions.

★ *Runway Temperatures* ... The ambient temperature is all important in jet operation.

★ *Freezing Level* ... Glaze and rime ice are of lesser importance to jet aircraft due to their high cruising altitude.

★ *Altimeter Setting* ... A forecast altimeter setting is essential for safe flight.

★ *Trail Levels* ... Condensation trail levels are important for security reasons.

★ *Tropopause* ... The tropopause has the same effect at altitude that an inversion has near the surface.

★ *Turbulence* ... What may be a slight bump in a C-47 becomes severe turbulence at 500 mph.

★ *Alternates* ... In doubtful weather, two or three alternates should be given, with fuel as one of the primary considerations.

To aid in making a safe IFR flight check your base weatherman for the complete picture of conditions aloft.

the latest altimeter setting is available, but a great change is possible over a distance of 400 miles, and a forecast altimeter setting is essential for safety. This is particularly true when the letdown is made in mountainous terrain.

Inherent error in the altimeter at high speed is a new problem. Here is a simple method for compensation that should be borne in mind. For every mile per hour increase of airspeed above 200 mph, the altimeter will indicate one foot too high. In other words, at 600 mph the aircraft will be 400 feet lower than the altimeter reading.

Tropopause

The Tropopause has the same effect at altitude that an inversion does near the surface. Above the Tropopause the visibility is unlimited, while below it the forward visibility is often limited by heavy haze layers or a thin deck of cirrus. Every rated man has topped a smoke, haze or fog layer into a clear sky, and this is the feeling when passing through the Tropopause. With present jet aircraft flight above the Tropopause is impossible during the summer months because of the height at which it is located.

In the winter months the Tropopause is located well below maximum operational altitude. Turbulence at the Tropopause varies from light to severe, but the smooth unrestricted flight above is the reason for cruising well upstairs.

Turbulence

Areas of turbulence are important because of the high rate of speed of jet aircraft. An area of light bumpiness in a C-47 traveling 160 mph becomes severe turbulence when encountered at 500 mph. Consequently, the pilot should know about those areas in which turbulence may be encountered.

Jet Streams

Here is a phenomenon that a weather officer with only a surface and 700 millibar chart is powerless to locate. A full complement of constant pressure charts is a necessity. When no facsimile charts of the 500, 300 and 200 millibar levels are available, a call to weather central is the best solution. The reason for locating the jet stream becomes apparent when one realizes that it is strictly a one way aid and must be avoided when traveling in the opposite direction. Aircraft flying against the jet stream have been forced to jettison their ordnance before reaching the target.

Here's a good tip for the pilot. If he finds that he is five minutes or more behind on his navigational check points, he should descend a thousand feet and recompute his groundspeed. Possibly he has been bucking the jet stream and really spinning his wheels. Luckily, this phenomenon is a problem of concern only from the latter part of October through April. It is usually of little consequence the remainder of the year.

Alternates

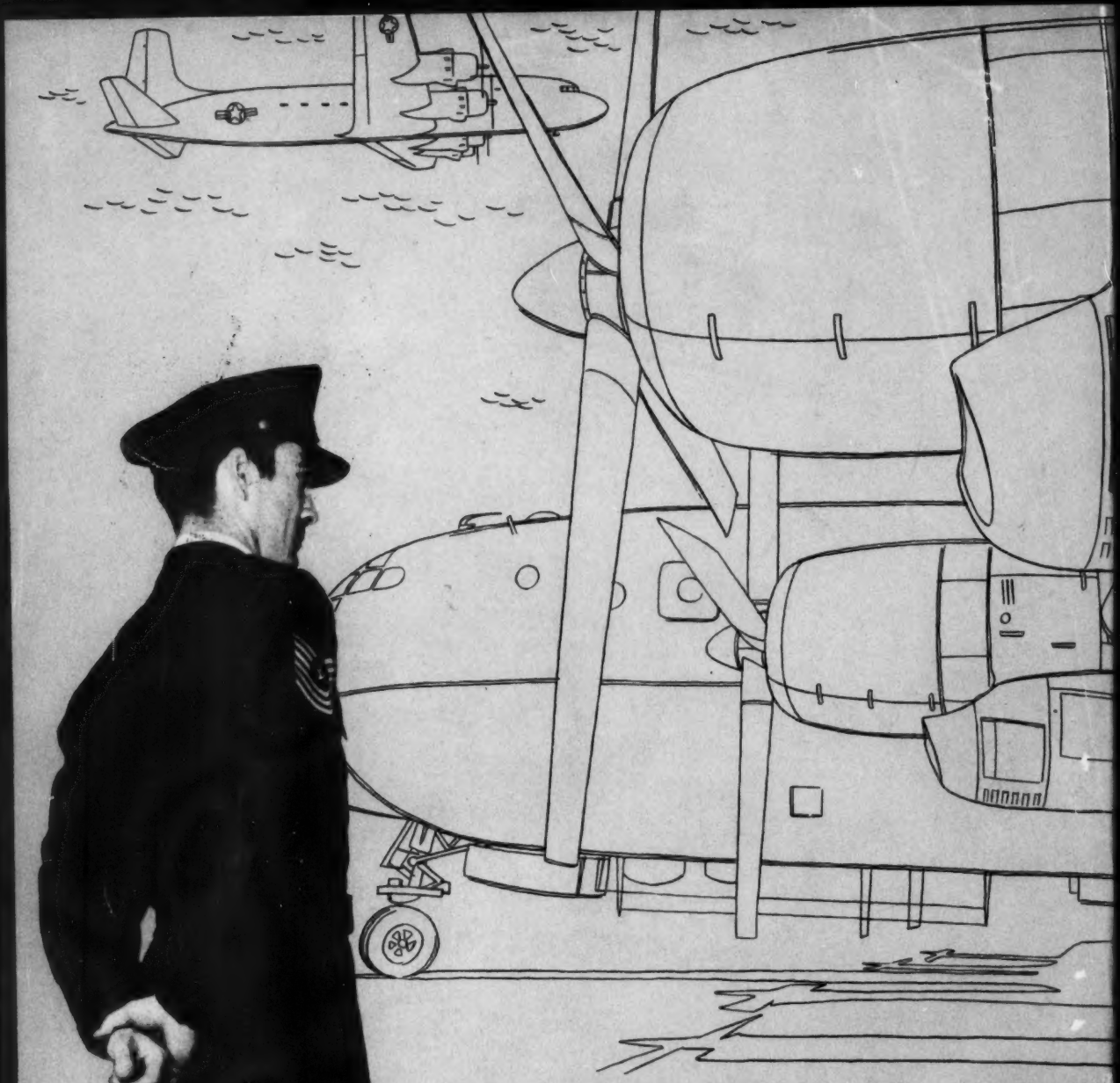
In periods of doubtful weather two or three alternates should be given. The operations officer will take the weather into consideration when planning the mission and add enough fuel for a margin of safety. Jets are unable to proceed to an alternate after the letdown is completed because of limited fuel supply. They must be notified that the alternate is to be used before a letdown is started.

All things considered, one of the most difficult problems facing the staff weather officer is gaining the confidence of the personnel he is serving.

The rated forecaster who is also a jet pilot will find this much easier. He is able to understand the problems of a jet pilot and can present the briefing with these problems in mind.

In the interest of greater safety, the importance of weather actually encountered should be discussed with each member of a returning flight. Although the majority of pilots are experienced and give reliable reports, a more accurate picture of the weather en route and return could be given in many instances. No two men see the same thing. Careful analysis and correlation of reports on the part of the forecaster will aid immeasurably in planning subsequent flights.

50
YEARS OF
POWERED FLIGHT
Aviation stands on the threshold of a golden age. The next 50 years will see advancements and developments even greater and more rapid than those of the past. Safety must remain an inherent part of our future.



For a Merry Christmas .. Fly Safe!

THIS is the threshold of the 1953 holiday season. Christmas
soon be here and thousands of service personnel will be go
home for the holidays.

As an Air Force pilot, a tremendous responsibility rests on y
shoulders—whenever you fly, whatever the season. But during
coming holidays, when you are likely to be transporting many tra
ing servicemen, we enjoin you to be doubly cautious.

Remember AFR 60-1, which prohibits f
solely for the convenience of individuals or g
After a flight is scheduled, remember your resp
sibility, both to your passengers and to your
Plan your flight. Fly your plan. Fly safely.

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